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The Journal of the American Museum of Natural History

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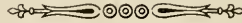
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NATURAL HISTORY

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AN ILLUSTRATED MAGAZINE devoted to the advancement of natural history, the recording of scientific research, exploration, and discovery, and the development of museum exhibition and museum influence in education.

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HAWTHORNE DANIEL
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A. KATHERINE BERGER
Associate Editor

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ONE OF THE NUMEROUS 1930 ERUPTIONS OF MONT PELÉE

Photographed by Mr. Frank A. Perret from his field station on Morne Lénard. This eruption shows a small fragmental lava flow descending the slopes of the volcano. As noted on page 36 four types of downrush are distinguished by Mr. Perret

(See *"The Volcano Museum on Mont Pelée,"* Page 31)

VOLUME
XXXIII

NATURAL HISTORY

NUMBER
ONE

JANUARY-FEBRUARY, 1933



THE MONGOLIAN WILD ASS

The Fleet-footed "Kulon" of the Desolate Plains of Central Asia

By ROY CHAPMAN ANDREWS

Leader of the Central Asiatic Expedition and Vice-Director
(In Charge of Exploration and Research), American Museum

ON June 26, 1922, the Central Asiatic Expedition pitched its tents on a gravel plain not far from the Eastern Altai Mountains in the Gobi Desert. The country was desolate but strangely fascinating. From the door of my tent I could look south to the splendid mass of Baga Bogdo, its snow-capped peaks whiter than the clouds which always drifted about their summits. In the distant foreground was a long, flat-topped ridge, blood-red except for an upper gray-white stratum. Nearer were other hills and buttes of red, white, and yellow, cut and sculptured by the winds and rain. To the west the gravel plain, sparsely studded with desert vegetation, stretched away to meet the black thrust of a lava flow; east of us across the wide river valley a similar gravel plain extended, losing itself in the everchanging mirage.

Summer had come in a day and breathless stillness lay upon the desolation of painted bad lands. The flowing waves of heat gave weird, fantastic shapes to rocks and grass; antelopes seemed to dance on air and flying birds to run upon the ground. Lakes with reedy shores and wooded islets appeared where we knew there were no lakes; somber forests offered

the coolness of shaded glens. It was an unreal world, menacing yet alluring.

As I gazed across the plains, the sky darkened and a subdued roar came out of the north. I felt a sudden blast of cold air and turned to see a storm sweep from the dry river valley and rush away to the west at race-horse speed. In its wake lay a narrow trail of white hailstones, as large as pebbles. A moment later the desert was flooded with yellow sunlight which seemed to have passed through amber glass before it reached the plain. Throughout the summer this narrow track over which the hailstones were spread remained as a well-defined band of green. Thus quickly does the desert respond to the slightest moisture.

Larsen was standing beside me, watching the rush of the storm through field glasses. Suddenly he gave an exclamation and pointed to a cloud of dust less than a mile away. In the midst of it we could see three dun-colored animals. They were wild asses! One was standing quietly while a huge stallion chased the other in circles.

Five minutes later, Colgate, Larsen, Shackleford, and I were in a car speeding toward them. We were all excited, for it



ALLUVIAL FAN AT THE BASE OF BAGA BOGDO

This great fan was ten miles in length and two thousand feet high. It was composed of débris washed out of Tiger Cañon, shown at its apex, by the torrential rains which fall on the mountains but do not reach the desert only a few miles away

was our first sight of a new animal and one we had come far to seek. While we were still half a mile away, they began to run west by south but going rather slowly, now and then stopping to glance back at us. They looked very neat and well-groomed in their short summer coats, and galloped easily. Suddenly they disappeared in a shallow draw with a narrow, rocky entrance, where we could not follow. Colgate jammed on the brakes, and by the time they were in sight on the opposite side we had opened fire, but they were beyond the range for accurate shooting and our bullets did no harm. They ran south from the valley into sandy ground and where we could make no speed. Reluctantly we admitted that they had outgeneraled us. On the way back to camp we saw four more asses—two mares, each with a colt,—but they, too, kept to the sandy plain and left us far behind. The first chance had given us valuable experience,

for we realized that it was useless to follow the animals when they were south of the gravel plain on which the camp was pitched. Subsequently we found that there were many wild asses in the vicinity, and we had a splendid opportunity to study their life history.

The Mongolian species, *Equus hemionus typicus*, was little known to the scientific world. No museum in America had specimens, and I believe there are only one or two skins in England, although the Tibetan species, *Equus hemionus kiang*, is fairly well known. In Douglas Carruthers' *Unknown Mongolia*, J. H. Miller has given a short account of the wild ass of Dzungaria, and a photograph of a dead specimen as well as of a young living animal which had been domesticated by a Chanto native.

Two days after our arrival, Larsen discovered a fine stallion not more than a mile and a half from camp. He was

drowsing in the sun and stood absolutely motionless except for an occasional flick of his tail and lazy movements of his long ears. We watched him through field glasses for a time and then Larsen, Colgate, and I started out in the car.

Profiting by previous experience, we drove almost due south and cut him off from the sandy ground on the lower plain. He seemed to divine our intentions at once and ran for all he was worth toward Baga Bogdo. Colgate stepped on the gas and the motor leaped forward at forty-five miles an hour. The animal could not do better than forty miles, even when straining every muscle to cross in front of us, and that extra five miles was just enough to decide the race. He turned back on the plain and headed straight for the black lava flow a mile to the west.

It was thrilling when we rushed along

within fifty yards of the splendid animal, the first we had seen in action at close quarters. I hated to give the word to stop, but he was dangerously near to the lava, and Colgate jammed on the brakes just as he crossed in front of us. The first bullets turned him northward and we leaped back into the car to follow. He had a start of four or five hundred yards but was going perceptibly slower. To add to the excitement, a second ass appeared, seemingly from the air, and galloped parallel with us. It was almost within range, but the first one evidently was in difficulty and I fired again at three hundred yards. He winced, ran a few steps and rolled over, legs waving wildly in the air. We all yelled as he went down. It had been a great race and a new animal had been added to my long list of Asiatic game.



ROY CHAPMAN ANDREWS IN THE MESS TENT AT KHOLOBOLCHI NOR

The tents were pitched on a grassy lawn at the very edge of a salt lake in the middle of the desert. The lake was only about five feet deep but contained thousands of small fish, which often awoke the members of the expedition by their flapping at night when they were stranded on the mud banks



MONGOLIAN WILD ASSES

On the desert north of Baga Bogdo hundreds of wild asses gather late in June to give birth to their young. The mares evince considerable affection for their offspring.

I could hardly wait to examine the specimen. It was a stallion and proved to be the handsomest one we ever killed. The yellow-fawn color of the upper parts shades exquisitely into the pure white of the belly and rump patch. The mane is dark brown and short; from the mane a chocolate-colored band, margined with white, runs to the tail which is tufted and rather mule-like. The ears are longer than those of a Mongol pony but are by no means as large as a donkey's; in fact, the appearance of the animal is like a fine-bodied mule.

In the days that followed the killing of our first wild ass, we hunted the animals industriously and soon had obtained all the specimens that were needed for museum purposes. Then we turned our attention to getting still and motion pictures, for this species had never been photographed.

The Mongols told us the most amazing

tales of the speed and endurance of the "kulon," and I was anxious to obtain accurate data. One day we discovered a fine stallion well up on the plain near camp. It was in such a position that we could prevent it from reaching either the soft ground to the south or the western lava flow. Shackelford and I spent two hours in the car following the animal, besides exposing one thousand feet of motion picture film and many still negatives. The ass was very clever in its attempts to reach the sandy ground of the lower plain, but each time we were able to turn it back.

The highest speed that it could reach was forty miles an hour; however, this could be maintained for only a short dash, perhaps two furlongs. Subsequently we found that only a few of the fleetest individuals could reach that speed but that all could do thirty-six miles an hour when galloping full out. Thus there was a



PART OF A HERD OF ONE THOUSAND WILD ASSES

When Doctor Andrews ran beside the herd in the car, they created such an enormous dust cloud that it was impossible to obtain satisfactory photographs of the main herd

difference of four miles an hour between the speed of the slowest and the fastest animals.

To me the most amazing exhibit was the endurance of the wild ass. The stallion which we followed traveled twenty-nine miles before it gave up. The first sixteen miles were covered at an average speed of thirty miles an hour, as well as could be estimated. During that time there never was a breathing space; it would sometimes slow up to twenty-five miles an hour, when it had evaded us by a sharp turn, but a few moments later would speed up to a rate of forty miles as it tried to cross in front of the car. Once we pounded along fifty feet apart for a considerable distance at thirty-six miles an hour.

After sixteen miles the ass began to slow up perceptibly but kept doggedly at it, averaging almost twenty miles an hour for four miles more. Then he reduced his

speed to a slow canter and resorted to more frequent twisting and turning to throw us off his track. Finally he stood quietly and Shackelford decided to lasso him. Fortunately, I did not fasten the end of the lariat to the car as Shackelford had suggested, for the instant the rope settled over the animal's neck it lashed out with both hind feet, badly damaging the radiator, and then started off on a sharp angle at a twenty-five mile an hour sprint.

We had other opportunities later to check our observations as to speed and feel sure that we are correct in saying that forty miles an hour for a short dash is the greatest speed any of the Mongolian wild asses can reach. However, this is considerably better than a wolf can do, for after several runs, we were convinced that thirty-six miles an hour is the Mongolian wolf's fastest pace. The wolf is the only natural enemy of the wild ass.



WILD ASSES ON THE DESERT

This gives an excellent impression of the character of the Gobi desert. It is a terrain of fine gravel, sparsely covered with low sage brush and bunches of hard, wirelike grass

I was greatly interested in the way the wild ass runs. The head is held high and the tail low; the animal is always "collected" like a polo pony, and never extends itself as does a race horse, except when putting on its utmost speed in a short dash. Because it is always so well collected it can reach full speed within a very few yards. This, I imagine, is a certain protection from wolves, for their attack would come only as a sudden dash from a ravine or other cover. None of those which we saw exhibited any indications of having been attacked by wolves, although they often showed scars which were obviously from wounds acquired by fighting among themselves. I witnessed several such battles—the two combatants rising on their hind feet and striking and biting furiously at each other.

All the wild asses which we killed were in splendid condition. There was a thin layer of bright yellow fat under the skin,

yet when the animals had a hard race the sweat was clear, with none of the lather which proclaims a horse to be "out of condition."

Miller remarks: "During the summer they frequent foothills, where the grass does not get so burnt up as on the plains; during the winter they roam all over the steppes, eating snow in place of water." This, of course, refers to the wild asses of the far west and Dzungaria. In the central Gobi where we encountered them, they were feeding upon the dry desert vegetation such as camel sage, low, thorny bushes, and stiff bunch-grass. This is the same food which the desert gazelles and our camels preferred. We never saw them close to the foothills where there was abundant grass, even during the driest and hottest months of summer; they were invariably to be found well out upon the desert. The only time I have ever seen them eating green vegetation

was in 1925, when we explored a narrow valley about one hundred miles in length parallel with the base of the eastern Altai Mountains, just west of Ikhe Bogdo. There was a great concentration of game in this valley, wild asses, both grassland and desert gazelles, and hares. At first we were at a loss to account for it, until we realized that they were all feeding upon a species of wild alfalfa. About the edge of Tsagan Nor, where we camped for several weeks, there was much green grass; at the western end a small river, the Tatsin Gol, runs into the lake, and for a number of miles along the banks there is excellent grazing. Yet, we never saw wild asses in this vicinity, although there were literally thousands of them upon the desert plain only a mile or two away.

Miller's statement that the "kulon" came to various springs to drink and that

they eat snow in winter is interesting as differing from our experiences. The water of Tsagan Nor was only slightly brackish, and our camels drank it eagerly, yet we never saw either wild ass or gazelle at the lake nor were their tracks to be found in the marginal mud. I was particularly careful to examine the shore line for such indications of their presence. At a spring near our camp at Loh there were so many tracks of ponies that we could not distinguish whether wild asses came there, although the Mongols said that they did. In the "Grand Canyon," to the west of Loh, there were many of their tracks about the spring.

South of the Altai we explored one of the most barren deserts that I have ever seen. For many miles there was no water except at a few wells along a caravan trail. In this desert we saw a few "kulon," but not many. I attributed



WITH HEADS HIGH AND TAILS LOW

These two wild asses ran straight for the sand dunes at the base of the Altai Mountains. The animals seemed to know instinctively that if they could reach the soft, sandy plains, the motor car could not follow them

their scarcity to lack of food, for there was virtually no vegetation of any sort, rather than to absence of water. It is my belief that wild asses require but very little water; that, as in the case of other desert animals, the starch in the vegetation which they eat is converted by digestive processes into water which is sufficient for their needs. In the Gobi, during the summer, there is almost no rain and little dew; there is no way for the animals to get water in many parts of the desert where they are abundant.

The "kulon" and the desert gazelle live under like conditions in the same regions and are frequently seen together. In fact, if we followed a herd of asses for a few miles in the motor car, gazelles almost invariably came from either side to join in the chase. I feel certain that the gazelles do not require water. In 1925 we found a "kulon" and a gazelle which

appeared to be inseparable companions. Day after day they were in the same place grazing together, never more than a few yards apart. On the plain at Loh there were usually one or more wild asses in sight from the camp. With the aid of field glasses I used to watch them throwing dust over themselves, grazing, or drowsing peacefully in the sun. Once or twice I saw one lying down.

The "kulon" of the central Gobi begin to drop their young during the last week of June, and we saw newly-born young as late as July 10. On July 6, 1922, Shackelford and I caught a baby wild ass which we kept as a pet for six weeks. The little fellow was not more than three days old and ran beside his mother in a stiff-legged, uncertain manner that was most amusing. He could not go very fast and before long stopped. Shackelford roped him without difficulty and we took him back to camp.



"BUCKSHOT" FEEDING THE WILD ASS COLT

This little animal lived with the expedition for six weeks and was fed on tinned milk and goat's milk. It never became tame except with "Buckshot," who cared for it. The colt would follow him around like a dog, even into the cook tent



PHOTOGRAPHING THE BABY WILD ASS

The young captive is shown posing for J. B. Shackelford, photographer of the expedition, a few minutes after it was captured

He looked like a small, woolly donkey. In a short time "Buckshot," one of our Chinese assistants, taught him to drink tinned milk from a canteen, and the little chap appeared to be quite contented with his new diet. A few days later we purchased three goats from a Mongol, but they did not give sufficient milk to satisfy him.

I hoped to be able to bring him back to America for the New York Zoological Society, but on August 18 he died. He had lived precariously upon tinned milk and goat's milk, and appeared to be strong although he increased very slowly in size. At Artsa Bogdo in August we got a plentiful supply of cow's milk from the Mongols, but it seemed to be too rich for the baby ass and he died within a few days.

I have never seen such a wild, untamable animal. Even though it was treated with the greatest kindness by all

of the men, it never lost its fear except with "Buckshot," who fed and attended it constantly. Whenever anyone else would approach the animal, it dilated its eyes and kicked viciously. Eventually it learned to follow "Buckshot" like a dog and would even enter the cook tent if he happened to be inside. At the end of six weeks, when it died, it appeared to be even more frightened of the rest of us than when it was first captured.

Possibly this may have been due, to a certain extent, to the fact that the animal was a stallion. On June 24, 1925, McKenzie Young and I captured a female which was not more than a day old. This one appeared to be much less frightened and to have a more gentle disposition. Unfortunately, it escaped after two days, so that we did not have an opportunity to learn more of the comparative docility of the sexes. As it was a cold evening, the baby ass had been buttoned up in a leather



THE EXPEDITION'S CAMEL CARAVAN
On the way to Shabarakh Usu where the dinosaur eggs were discovered

waistcoat belonging to Lieutenant Robinson and had my police dog's collar about its neck. The rope became loosened during the night and the foal wandered off. Doubtless it died, for certainly no other ass would allow it to approach with the man-scent upon the vest.

If I were to try again to bring one back for the Zoological Society, I should purchase a pony mare from the natives and teach the little ass to nurse from her, for I am convinced that it never would prosper upon other milk. A Mongol told me that he had reared a wild ass colt which he persuaded a pony mare to adopt. At first the mare would not allow the youngster near her; then the Mongol conceived the idea of pouring some of her own milk over the baby ass and this soon solved the difficulty. The animal flourished but was always wild and difficult to approach, except by its owner. He never was able

to break it to the saddle or use it in any other way. The ponies would not allow it in the herd with them. The Mongol bred it to a pony mare and the resulting mule, although a fine strong animal, could not be ridden.

Mr. F. A. Larsen, who was with us in 1922, is a well-known horse dealer, and had hoped to capture several wild asses for breeding purposes, but after our experience and that of the Mongols, I believe it to be very doubtful whether they would produce usable mules.

Like the desert gazelles, the "kulons" seek a flat plain upon which to drop their young. They are particularly careful to avoid a region of ravines or gullies which might give cover to wolves. Also like the gazelles, they gather into herds, largely composed of mares, just before the young are born. The stallions do not entirely leave them but remain somewhat separated. Later in the summer many of the males range by themselves. The solitary in-



LEADER ANDREWS WITH A BABY CAMEL
Young camels are exceedingly delicate and the Mongols usually cover them with a small felt blanket in order to prevent their catching cold



THE EXPEDITION'S CARAVAN ARRIVING AT TUERIN

The caravan had started six weeks in advance of the motor party and arrived at the rendezvous but two hours before the cars

dividuals which we saw were invariably stallions.

The mares evince considerable affection for their young and when we were following a colt in the car the mother would remain close to it, regulating her speed to that of the baby. It was interesting to see how quickly the colts were able to run. Several that we estimated were not more than a week or ten days old could reach a speed of twenty-five miles an hour and maintain it for a mile or two. They tired quickly, of course, but it was by no means easy to capture them, for they could dodge and twist with the greatest agility even though too exhausted to keep up a steady pace. I shot several young for a group in the American Museum of Natural History, but had great difficulty in getting good specimens. The colts were usually badly scarred, as if from bites, and two were suffering from a skin disease like eczema.

The first two weeks of life must be the most critical for them, for then wolves could catch them easily if they were unprotected by their mothers. On the great plain north of Tsagan Nor, however, where two or three thousand wild asses had gathered to foal, I did not see a single wolf, and carcasses were left untouched except by birds. A short distance to the west, across the Tatsin Gol, a small river empties into the Tsagan Nor, where a second great plain exists. It is exactly like the other, but there were few asses upon it and if they were driven away from Tsagan Nor they would drift back in a day or two.

The hard gravel peneplain north of the White Lake (Chagan Nor) swarmed with wild asses and antelopes. It is an ideal breeding place for both animals because there is no cover for wolves. One day Shackelford and I went out in a car, particularly for photographs. Seven miles



THE EXPEDITION'S CAMP AT SHABARAKH USU

On the basin floor half a mile from the Flaming Cliffs, where the dinosaur eggs were discovered. Behind lay the Tamarisk grove where the Dune Dweller culture was found

from camp we stopped on the edge of a wide, shallow depression. Even with the naked eye we could see hundreds of yellowish forms swimming in the desert mirage: wild asses, without a doubt, but never before had we seen a herd so vast. They were massed in three dense groups on the valley floor, and for miles the horizon was dotted with stragglers. By counting a block of two hundred we could estimate fairly accurately that there were at least a thousand animals in the herd. Subsequently, we learned that there were many more than that, for several hundred were below our sight in the bottom of a shallow ravine.

It was obvious that we must circle far to the east and drive the herd westward on to the gravel plain where for fifteen miles we had splendid running for the car. When we finally headed toward the asses a group of forty surprised us before we reached the main herd. The animals began running rather slowly, stopping often to gaze curiously at the car. We did not press them, but maintained a steady

pace of twenty miles an hour. The asses kept their distance ahead of us easily enough and others began to come in from every side. The car drew them like a magnet.

The yellow stream of animals converged on a course which brought them in front of us in a thundering mass. Hundreds were pounding along on both sides and we were enveloped in such a cloud of dust that I could barely see to drive. Photographs were impossible until we escaped from the dense herd of fleeing animals. I dropped back and swung to the outside of the largest group. There were perhaps three hundred asses so closely packed that they were running head to tail. As we shot forward beside the leaders the herd swung like a troop of cavalry and tried to cross our front.

Shackelford, braced on the rear of the car, ground off film, swinging his camera from side to side as the mass divided. The fleetest individuals kept together but the slower dropped behind, separated into groups of ten to thirty, and took their



MONGOL VILLAGE AT AN OASIS NEAR BAGA BOGDO

Small streams coming down from the mountains gave fine pasturage for flocks of sheep, goats, and horses

own courses. But soon the small herds began to converge again and so the performance was repeated. By the time we had reached the western end of the plain which drops off steeply into the wide valley of the Tatsin Gol, asses were pouring over the rim like a cataract of yellow water.

When we turned back we encountered single stragglers running about with their noses held high in the air, trying to find their companions. Yet they could not resist the fascination of the car; before we had gone a mile, more than a hundred were pounding along in front. Fifteen or twenty gazelles joined the parade, running with stiff black tails erect, sometimes springing into the air as if they were on pneumatic tires.

I let the herd cross our bow and swung away to the south. With the glasses we could see nine grazing quietly two miles away. We decided to try a new plan. Running a few yards we stopped the car. The asses looked up, trotted toward us and stood with ears erect. Again they

advanced and again. Before long they were within less than two hundred yards and Shackelford could work with the telephoto lens.

This seems to be the only way to get pictures of the animals when they are not in rapid motion. It is impossible to stalk them on the plain for there is no cover. They do not often come to water holes as they seldom drink. One cannot successfully lie in wait for them anywhere, since they have the whole vast plain upon which to wander.

The "kulon" seemed to prefer the hard gravel plains and would run only into the sandy country in order to get away from us in the car. They appeared to know instinctively that we could not follow them there and would always make a direct line for soft ground, or into the lava flows which cap part of the region about Loh.

The car had an irresistible attraction for them, as it did for the gazelles, ponies, camels, and all other animals on the plains. When we were running an ass, it would

make a supreme effort to cut across in front of us, sometimes missing the car by only a few feet. If there were several hundred asses upon the plain, we needed only to drive up the center to have the animals come in diagonally from both sides, as though drawn by a magnet; after a few miles the whole mass would be thundering along in front of us. Usually such a spectacle was too much for gazelles in the vicinity and they, too, would join the procession.

Miller remarks that the eastward range of the wild ass is unknown. We can give some accurate data upon the subject since we came always from the east. The most eastern record which I have is of a single individual that we encountered just south of the Gurbun Saikhan, of the eastern Altai, in 1925. This is latitude N. $43^{\circ} 30'$, longitude E. 105° , and is six hundred miles from Kalgan. In 1923 we

saw a single wild ass near Artsa Bogdo, sixty miles farther west. Thirty or forty miles still farther west they became fairly abundant, and at Tsagan Nor hundreds can usually be found.

As we explored the country for three seasons very carefully, I feel convinced that the Gurbun Saikhan is their easternmost range north of the Altai. South of the Gurbun Saikhan we saw none, although we traveled a long way to the east.

Just why the wild ass should so suddenly stop at this point is rather puzzling, for the country to the east for several hundreds of miles is essentially like that of the Tsagan Nor region, with similar climate, vegetation, and terrain. Westward, both north and south of the Altai, we saw wild asses, but in no place were they so abundant as on the Tsagan Nor plains.





BREAST ORNAMENT OF
GOLD WITH TURQUOISE
MOSAIC. MIXTEC CULTURE.
MUSEO NACIONAL MEXICO

THE WORSHIPPERS OF THE AZTEC WAR GODS

A Brief Description of Tenochtitlan, the Ancient Mexico City at the
Time of the Landing of Cortez

By GEORGE C. VAILLANT

Associate Curator of Mexican Archaeology, American Museum

DRAWINGS REPRODUCED FROM THE CODEX FLORENTINO, EDITED BY SAHAGUN IN THE SIXTEENTH
CENTURY AND PUBLISHED BY PASOY TRONCOSO, MADRID, 1907

WHEN we realize that the Mayas were in a state of decadence at the time of the Spanish Conquest, and that we recreate much of the splendor of their civilization from the eloquent silence of their ruined architecture, it is well to consider the aspect of the Aztecs who were at their zenith in 1519. Although the Spaniards and their myriad allies so thoroughly razed Tenochtitlan that only a few foundations now remain, there fortunately exists much descriptive information gathered by such eye-witnesses as the Spanish soldiers and the missionary friars, as well as the testimony offered by the documents of the Aztecs themselves.

Bernal Diaz tells how his comrades-in-arms on first beholding Tenochtitlan exclaimed, "It is like the enchantments they tell of in the Legend of Amadis. Are not the things we see a dream?"

This is lyric language from hard-bitten

men-at-arms whose chief avocations, while engaged in converting the heathen, lay in acquiring booty and enjoying the charms of dusky Dulcineas. Yet in contrast to the drab towns and tawny hills of Spain, Tenochtitlan must have appeared a Paradise indeed, with its green gardens and white buildings set against the blue of the lakes. "Gazing on such wonderful sights," writes Bernal Diaz, "we did not know what to say or whether what appeared before us was real, for on one side on the land there were great cities and in the lake ever so many more, and the lake itself was crowded with canoes, and in the causeway were many bridges at intervals and in front of us stood the great City of Mexico, and we—we did not even number four hundred soldiers!"

Although socially and governmentally Tenochtitlan was distinctly American Indian, outwardly it appeared the capital

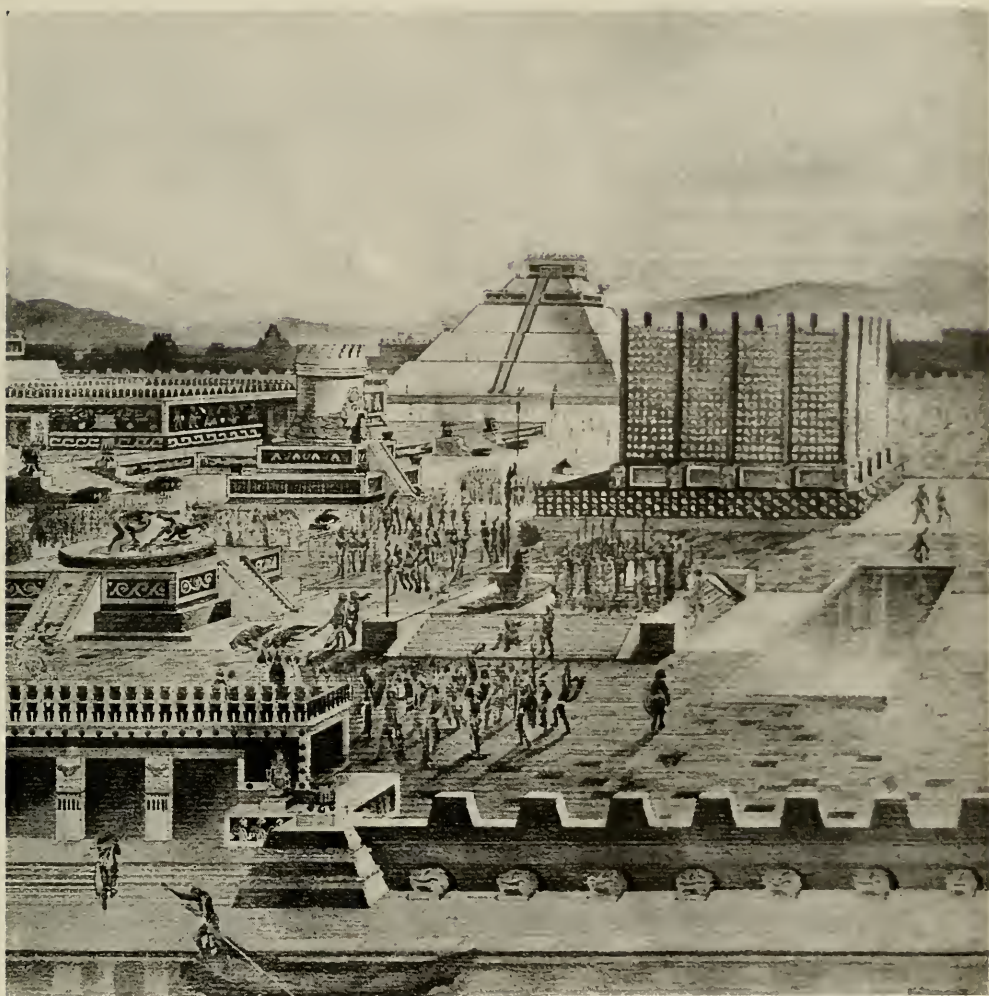


THE GREAT PLAZA

A reconstruction by Ignacio Marquina, chief of the Direction of Prehispanic Monuments, Ministry of Public Education, Mexico.—The scene is shown looking from the north. In the foreground we see the termination of the northern canal, the wall studded with serpents' heads which surrounded the sacred precinct, and an ornamental gateway. At the left is shown the palace of Axayacatl, head war-chief before Montezuma, the place where the Spaniards were lodged. Next to it rises the great temple to the gods Tlaloc and Huitzilopochtli, the scene of many a bloody sacrifice. Placed horizontally above the platform at the foot of the stair is the circular stone recording the triumphs of the Chief Tizoc, and set vertically against the same platform is the famous Calendar Stone. In the left background may be seen the old temple to Huitzilopochtli. At the left of the Great Temple stretches the rambling structure occupied by Montezuma, and behind it rises a temple to an unidentifiable deity, perhaps Tezcatlipoca.

city of an empire. A bird's-eye view would reveal an oval island connected with the mainland by three causeways which were pierced by bridges and which converged at the center of the city. The edges of the island were fringed by the green of the "floating gardens," while

toward its center the shiny white of roof-tops predominated, the green being reduced to the little squares of the patio gardens. Thrust above the quadrate masses of the roof-tops loomed the various clan temples, each set on its pyramid. There were few streets or open spaces in



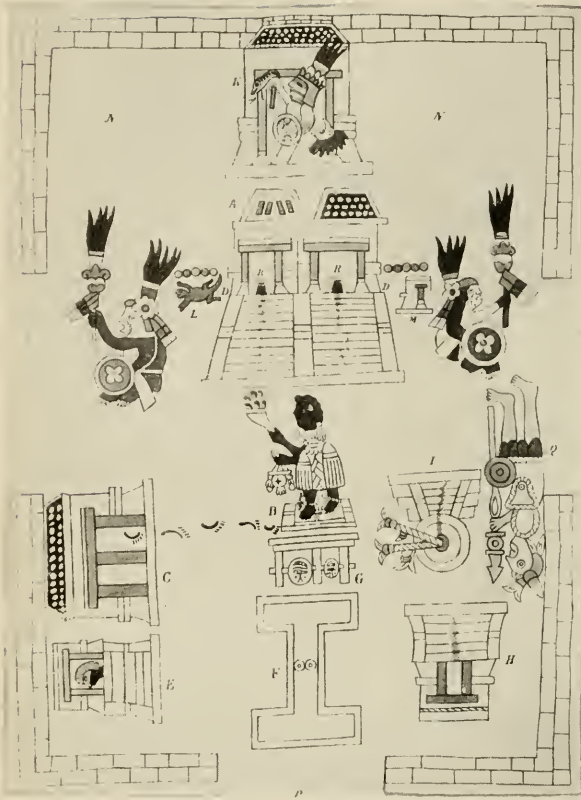
TENOCHTITLAN, MEXICO

In the center of the plaza is the circular stone used for sacrificial combats, wherein a fully armed warrior attacked a tethered captive equipped with inferior weapons. Directly behind this structure is the circular temple dedicated to Quetzalcoatl, God of the Air. Behind this temple and the palace of Montezuma is a pyramid and shrine, most probably for the worship of Xipe-Totec, the Flayed God. Flanking this temple on its left rises the sinister mass of the skull-rack. A pool of water and a devotional altar for worship to the gods of the Great Temple occupy the remainder of the plaza. In the background we catch glimpses of temples in other parts of the city, and behind them loom the snow-covered volcanoes Popocatepetl and Ixtaccihuatl. Compare this animated reconstruction with Sahagun's map on p. 20. The differences between the mnemonic and ritualistic character of the Indian drawing and the imaginative detail of the European presentation give a striking idea of the psychological contrasts in the Aztec and the European points of view.

the city, which was gridded with canals crossed by drawbridges but the plazas of the temple of Tlalteleleo and of the religious center of Tenochtitlan stood out from the pyramids and official palaces clustered about them. There must have been a curiously living quality about this

grouping, the temples seeming to ride like horsemen among the serrated ranks of the houses.

A visitor would be struck by the rich variety of the sights were he to transverse Tenochtitlan from south to north. Approaching along the causeway, the



SAHAGUN'S MAP OF MEXICO CITY

A.—GREAT TEOCALLI OF HUITZILOPOCHTLI AND TLALOC. B.—PRIEST OFFERING A SACRIFICE. C.—PRIEST QUARTERS. E.—EAGLE WARRIORS' QUARTERS. F.—BALL COURT. G.—SKULL-RACK. H.—TEMPLE OF XIPE. I.—SACRIFICIAL STONE, POSSIBLY STONE OF TIZOC. K.—TEMPLE OF HUITZILOPOCHTLI, THE ORIGINAL PLACE OF WORSHIP OF THIS GOD. LATER BUILDING "A" SUPPLANTED IT. L.—5 LIZARD (DATE) AND STATUE OF MACUILXOCHTIL, GOD OF FLOWERS. M.—5 HOUSE (DATE) AND STATUE OF MACUILXOCHTIL, GOD OF FLOWERS. N.—DANCING PLACES. THREE ENTRANCES TO THE TEMPLE ENCLOSURE ARE SHOWN IN THE SURROUNDING WALL, WHICH WAS ADORNED WITH SERPENT HEADS.

lings began to encroach on the gardens, and the waters of the lake shrunk to a canal following the roadway. The adobe walls gradually were replaced by the fronts of houses plastered white or with the rich dull red of powdered punice. For the first time the visitor realized how the city expanded through the artificial creation of beds of vegetation which in solidifying bore first a crop, then a modest hut, and finally became integral with the masonry of the city.

The causeway had now changed from a simple means of communi-

traveler of that time passed first between expanses of open water. Then gradually tiny islands of green appeared, the so-called floating gardens, made of masses of mud heaped up from the bottom of the lake and spread on reed rafts. White-clad farmers dexterously poled their tiny dugouts through the maze on their way to cultivate their garden truck. These irregular islets merged gradually into orderly groups, where the roots had established anchorage in the lake bottom and made more solid ground. Open water remained only in the narrow canals. Save for the broad causeways, roads there were none, and along the waterways one saw in increasing numbers boatloads of produce headed in toward the city. Here and there among the green one caught glimpses of thatched roofs and wattled walls, the huts of the farmers. Then adobe walls of more substantial dwell-

cation into the social complexity of a principal street. Since canals took the place of roads, space for a saunter was so rare that the causeways were as much recreation grounds as arteries of traffic. Thus people out to see the sights, people on errands, people on the way to the myriad functions of religious import swallowed up the long lines of trotting carriers who, bowed under their burdens, went to the city with produce and tribute, or left it with goods for barter. Outside the city limits the antlike streams of laden folk had been but rarely relieved by the rare passage of a civil functionary, all feathers and pomp, in his litter, or of a stern merchant with a handful of fighting men followed by a chain of apprentices, showing the whites of their eyes as they peered from under the press of the tumplines. Now could be seen men in rich mantles, sniffing flowers as they watched the

milling crowd and black-robed priests whose hair was matted with the blood of self-inflicted penance. There was little sound, there was little hurry, save for the carriers, trotting to reach relief from their burdens. But there was great vitality, that of a multitude of units participating in complex action, knowing each its allotted part but not the substance of the whole.

A glance into the doorway of a dwelling gave relief from the cold-blooded, almost insect-like quality of the life outside. A shaded patio was blocked in with buildings whose interiors were cool and spacious. Mats and straw cushions on the polished floor welcomed one to repose, while the rhythmic clap of hands and the scrape of stone on stone told that tortillas were being made and corn meal ground in a kitchen at the back. In a corner an elderly man was talking to two small boys, whose serious faces showed that, already conscious of their participation in the tribal life, they heeded their



INVESTITURE OF WARRIORS WITH TRAPPINGS OF CASTE

uncle's precepts. In a doorway a fat little girl vainly tried to imitate with her stubby fingers and toy instruments the graceful movements of her mother as she produced fine thread by the cunning manipulation of her spindle. Lolling on a cushion, a young man idly smoked, picking thoughtfully at the scarcely healed lobe of his ear, tattered by penitential blood-letting with cactus spine and obsidian blade.



Photograph from Ewing Galloway

THE "FLOATING GARDENS" OF MEXICO

A scene that might well represent the days before the Conquest. The people in the district of Xochimilco, where this picture was taken, still speak Aztec and live much as did their ancestors



Photograph from Ewing Galloway

THE ZOCALO, MEXICO CITY

The site of the ancient temple enclosure of Mexico as it looks today. The Cathedral is built in front of the great Temple of Huitzilopochtli. Compare with reconstruction on pages 18-19

A fiesta was going on in another house and one heard music, the rich vibration of wooden drums and the gay squeal of reed flutes. The patio was full of people gay in the bright colors of their holiday clothes, and the air was heavy with the cloying scent of lilies. The sharp smells of rich sauces cunningly mixed from many peppers embroidered this odor, and occasionally a light breeze wafted the cool, mystic scent of incense. Somebody was celebrating his birthday, since in the background one saw a painted figure adorned with maguey paper representing the titular deity for the day. A little apart from the feasters who partook of their entertainment with dignified pleasure, clustered a group of old men whose clownish gestures and burlesque solemnity could be easily associated with the cups that a slave was industriously filling for them. Not for nothing had they passed through the rigid self-denial of young manhood to be permitted alcoholic indulgence in their old age,

whenever a feast came to pass. A last backward glance revealed the musicians, garlanded with flowers, blowing their flutes and conch shells, while one beat on the head of a cylindrical drum and another the wooden tongues in the side of the two-toned *teponastle*.

Farther up the street the priests seemed to increase in numbers and more individuals wore the trappings of high office, such as the nodding panaches of quetzal plumes, and cloaks the designs of which were worked in feathers like the clan insignia on their circular shields.

Presently the causeway ended in a great open square where rose the majestic planes of the pyramids. In the hard, bright light of early afternoon, heat waves joined with smoke of incense in rendering indistinct and unearthly the outlines of the temples, and the short, black shadows suggested unspeakable things. Was it imagination or reality, that sickening odor of a filthy butcher shop, in bitter contrast to the immaculate pavement of the

courtyard? Imagination was too personal a sensation for an Indian community and the great block of the skull-rack gave the answer. Thousands of skulls were piled up in orderly symmetry, and the blacks of the eye sockets and nostrils of these sacrificed victims suggested heaps of infernal dice. A few young men were practicing in a ball court near by, thrusting at the ball with agile hips while striving to propel it through the rings set transversely to the walls along the length of the courts.

A circular stone set a short distance away was the scene of a most cruel game. Here on certain ceremonial days a tethered captive was allowed to defend himself with a wooden club against the onslaught of an adversary whose weapon was set with razor-sharp obsidian blades. Sometimes a victim would resist so suc-

902.



HOUSE OF WATTLE AND DAUB, USED BY THE POORER FARMERS

889.

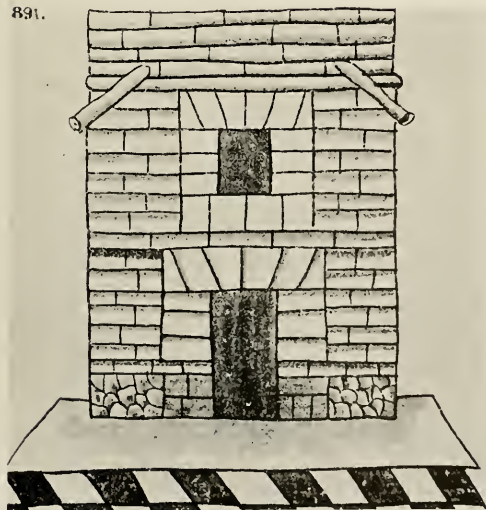


A NOBLE'S HOUSE. NOTE FRESCO AND STONE COLUMNS

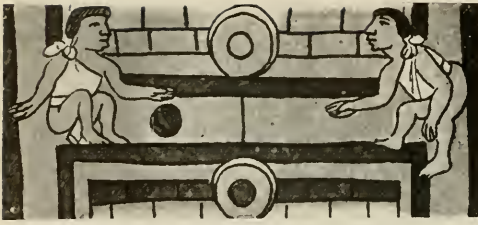
cessfully that he gained a pardon. The great disc of the calendar stone was placed vertically on another platform. Carved with consummate mastery of design, it represented the symbolic history of the world. A third great disc, carved on its face and edges, commemorated the far-flung conquests of the War Chief Tizoc.

A sacrifice was to be made. Before a small temple dedicated to one of the gods, a group was gathered, some in the gay panoply of merchants and others wearing the sinister black of the priesthood. Among them, tightly-pinioned, stood a slave, who looked unseeingly about him, resignation, not fear, in his face. The priests rushed him up the steep steps to the temple, the merchants following at more leisurely pace. Two priests, seizing the slave by either arm, forced him backward while two others pulled his legs out from under, until his body curved, belly upward, over the altar. A fifth priest dragged his knife in a long sweep from the breast-bone to the base of the stomach and, reaching into the aperture, with a

891.



TWO-STORY HOUSE OF STONE AND ADOBE



A BALL COURT. THE POINT OF THE GAME IS TO PASS THE BALL THROUGH THE RINGS

dextrous twist tore out the heart. They burned this on the altar, and the merchants, swinging long ladles of smoking incense, chanted their thanks for a safe and profitable excursion to the hot country.

Paying no attention to this pious little scene, knots of chiefs were converging on a large building at a corner of the plaza. The War Chief Montezuma was planning an attack on a neighboring town remiss in its tribute and there must be a gathering of the clan leaders. Adorned with helmets like the heads of jaguars, eagles, and wolves, girt with armor of wadded cotton brocaded in many colors or embroidered with feathers, their faces set with nose

and lip ornaments of jade and gold, these fierce-faced chiefs passed through the door, but before entering the council chamber they stripped off this finery. Then bare-headed and barefooted, with downcast eyes, they made their way before the throne where sat the slim figure of Montezuma the War Chief,

18.



BOYS GOING TO SCHOOL. NOTE THAT THE PARENTS WEAR THE DRESS OF POOR FOLK

79.



WARRIORS. NOTE RICH TRAPPINGS AND VICIOUS CLUBS OF WOOD, TOOTHED WITH OBSIDIAN

who was simply dressed but for the jade ear-rings and gold crown of his exalted office.

The austerity of the council chamber was not borne out by Montezuma's other apartments, which contained all the appurtenances of luxurious potentacy. Magnificent quarters were occupied by the War Chief's two wives and his many concubines. Kitchens and store houses were spread over another great space, for not only were some three hundred guests served at each meal but also a thousand attendants and guards. In contrast to the profusion within, outside the kitchen door squatted patiently a meager group of countrymen from whose carrying bags swayed the mottled heads of trussed turkeys to be offered to the larder.

Other apartments in Montezuma's palace contained the tribal treasure composed

of the tribute wrung from many pueblos. Gold, jade, rich feather mantles, baskets of produce were heaped in abundance. Clerks were listing the goods to see that each subject town had contributed its quota, or calculating the share that should be turned over to the various clan stewards. Another patio presented a more animated scene. Here acrobats were practicing their feats and poor, warped dwarfs were composing grosser



A PRODUCE MARKET. THE NEAT ARRANGEMENT OF WARES MAY BE SEEN IN ANY MEXICAN MARKET TODAY



PUNISHING MALEFACTORS. FOUR JUDGES SUPERVISE EXECUTIONS BY NOOSE AND CLUB

contortions to win a chiefly smile. In another set of buildings was housed the zoo, where serpents undulated sluggishly, and where from behind wooden bars peered the greedy, yellow eyes of jaguars and ocelots. In a side room, a human hand projecting from a basket of raw meat showed how the bodies of some of the sacrificed victims were utilized.

Extending north from this great plaza which even today is the center of the city, stretched the highway to Tlaltelolco. This wide road with a canal beside it was filled with the same indecisive multitude that filled the southern artery. The sinking sun had brought people out on their roof tops. Some leaned over parapets to watch the throng below, even as idlers squatting in a shaded bit of the street

took equal interest in the slow movements of the householders above them.

A path and canal debouching into the main avenue led to a small square, in the center of which loomed a pyramid. From the patio of a large building shrill cries arose and the dull clash of wooden instruments. Within, a number of boys were receiving instruction in the manual of arms. Each equipped with a small buckler and a flat club of wood, they learned the art of cut and parry under the scornful eye of a warrior. They dealt and received severe blows, but the clubs were not toothed with the wedges of obsidian, the volcanic glass that made hand-to-



A GROUP OF JUGGLERS. OBSERVE THE HUNCHBACKS IN THE LOWER ROW



STAIRWAY OF THE PYRAMID OF TENAYUCA

Near Mexico City. This is an excellent illustration of the dramatic quality of Aztec architecture

hand combat so vicious in war. Another group were practicing with the *atl-atl* or throwing stick. The marksman laid his spear along a narrow wooden trough hooked at the farther end, the nearer end being grasped in the hand. By lengthening the arm in this way it was possible to attain a greater propulsive force.

A less animated scene took place among the boys of the religious training school on the other side of the plaza. Their little legs and faces lacerated by maguey spines, their bodies thin from penance, and their eyes dulled by the monotony of self-denial, these children were chanting strophes from a ritual. The preceptor who led the singing showed in his own scarred and emaciated body that the propitiation of the gods was a relentless and never-ending task. Priest, chief, warrior, or husbandman, every Aztec from boyhood on, spent much of his life either in a kind of beseeching penance to ensure his future or in a state of grateful atonement for not having had a worse past. The Aztecs

lived on intimate if uncomfortable terms with the supernatural powers.

Another aspect of this lack of individualism was to be seen in the *teeapan* or clan building. Here elders of the clan were arranging the affairs of the group. One old man by means of maps adjusted a question of land tenure between two contesting families, making his judgment on the basis of how much land each family could cultivate by its own efforts. Another old man was distributing some pottery, given up as tribute from a town across the lake, to some of the poorer members of the community. None of these people bestowed more than an occasional glance into the back courtyard where an adulterer was being stoned to death by the members of the affronted family. Urban existence contained too many interests and life was too cheap for them to view as an excitement the inevitable result of wrong doing.

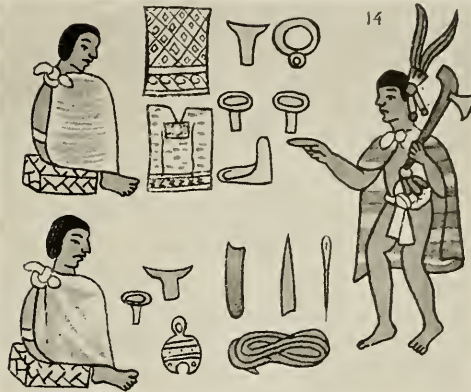
In many such centers each *phratry* regulated its own affairs. The great plaza

where Montezuma had his palace and where the gods were worshipped in many temples was for the use of all the clans together. Yet in spite of the importance of this center, the great plaza of Tlal-telolco near the northern edge of the island was almost as striking. The self-contained nature of a Mexican tribe did not diminish the governmental functions of a conquered people, who were supposed to furnish fighting men and tribute, once they acknowledged the sway of a superior power. Thus the recently conquered Tlal-telolco had a communal center as majestic as that of Tenochtitlan. It seemed more dramatic to Spanish eyes, perhaps because its great temple to Huitzilopochtli was thrust into prominence by the wide spread of the market place, while in Tenochtitlan the great buildings were so close together that it was hard to gain an impression of their size.



TRADE FROM THE HOT COUNTRY. JAGUAR SKINS, JADE, AND FEATHERS ARE OFFERED FOR SALE

The open space was divided into two sections. A large area of smoothly polished pavement was bordered by arcades which sheltered many of the merchants. At one edge was a basin opening from the canal beside the northern causeway, where the boats bringing goods and produce could find an anchorage. Each kind of product was concentrated in a special place. Thus one section was de-



TRADE FROM THE HIGHLANDS. GOLD, COPPER, OBSIDIAN, AND MANTLES ARE OFFERED IN EXCHANGE FOR TROPICAL PRODUCTS

voted to vegetables, and compactly squatting women sat watching their goods, which were arranged in symmetrical heaps on woven mats. In another section cotton mantles were being sold, some being spread to show the full design, and others neatly folded. Elsewhere was a row where tools were for sale, obsidian blades, spindle whorls of pottery carved and burnished, spoons of deer horn, bodkins of bone, and a few copper axes. A brilliant mass of color characterized the row of the feather salesmen. Some sold merely bunches of the feathers, the green of the trogon and the multicolored plumage of the parrots, while at the booths of the others cloaks, mats, and shields gave evidence of charming fancy and patient toil.



A SLAVE FAMILY. THE BARS ACROSS THE NECKS ARE THE SIGN OF BONDAGE



53.
GOLD WORKER MAKING A MOSAIC DESIGN LIKE
THE BREAST ORNAMENT ON PAGE 17

Jewelers displayed ornaments of jade, and gold worked into precious rings of filigree or massive, beaten gorgets. It was the jade, however, that caught the envious eye and was produced with furtive circumspection as material of great price. Other merchants sold ornaments of shell, and the pinks, whites, and subtle mottled browns of sea shells contrasted with the rich, dark sheen of the tortoise carapace. At one booth a rich warrior earnestly chaffered with the proprietor for an exquisite pair of ear plugs, cunningly inlaid with a mosaic of turquoise and shell.

The smiling whispers and admiring glances of the crowd when at the jewelers' abruptly changed in the slave quarter to appraising stares. Some of the chattels wore wooden collars and stared blankly with brutish eyes. These had reached their servitude through penalties for crime or by capture in war. Others were thin and emaciated, and did not wear the collar of bondage. They had met with misfortune and were selling themselves to ensure food and shelter.

A low hum rose from the market place: there was none of the strident shouting of a European fair. The bargaining for goods

was carried on slowly, quietly, but none the less keenly. The Aztecs had no money, so that barter was the usual means of purchase. The cocoa bean, however, had a standard value and this, in equalizing exchanges, performed the nearest approach to the function of currency. Passing through the crowd were warriors who acted as police, and should a dispute arise, they haled the disputants to a court where one of the tribal elders settled the question.

Beyond the market was a double line of walls which divided off the religious part of the plaza of Tlateloleo from the market. Rectangular buildings, with patios in their centers, housed the priests and the various schools and councils of the central organizations of the Tlatelolcans. Farther on were grouped the main temples of the various divinities. In the center the great temple shouldered its bulk into the sky. There was a skull-rack like the one in Tenochtitlan, and another heap was made of the bones of the victims. Near the great pyramid stood a circular temple, the door of which was built to resemble the mouth of a



80.
FEATHER WORKERS. IN THE DISTANCE A
MERCHANT BRINGS THE RAW MATERIALS FROM
THE TROPICS

serpent: the place of worship for the god Quetzalcoatl. The sacrificial block in front was black with the smoke of incense and the encrusted blood of victims. A pile of stone knives and axes gave a sinister indication of what rites were practiced there.

Pools of water fed by pipes from the aqueduct gave an impression of quiet peace and the reflections of the temples, distorted by an occasional breeze, intensified the brooding mysticism of the sacred enclosure. As a relief to the austerity of the scene young girls with downcast eyes slipped back and forth on the various errands of their training school within the enclosure. The great pyramid, that of Huitzilopochtli, the war god, completely dominated the place. Terraces breaking at intervals the line of the sloping sides increased the impression of its size. A wide staircase of one hundred and fourteen narrow steps led up the western side, and so steep was this stair that not until one's head rose clear of the platform, did the temple itself come into view.

The temple was, in reality, two shrines, built side by side, each having stone walls

96.



FARMER PLANTING CORN. NOTE THE USE OF THE PLANTING STICK

and soaring roofs of wood. Through the right-hand door, one could dimly see the squat figure of Huitzilopochtli carved in stone and then covered with a paste in which were set jade, turquoise, gold, and seed pearls. A girdle of snakes in gold picked out by precious stones adorned its waist, and around its neck hung a string of gold masks with turquoise mosaic. By its side stood the statue of an attendant deity with a short lance and a gold shield richly decorated with a turquoise mosaic.

In the other temple was an image of Tezcatlipoca, one of the most prominent Aztec gods. Its eyes were inlaid with mirrors of obsidian that gleamed reddishly in the afternoon light. This statue, too, was adorned with gold and precious stones. High in the wooden roof of the temple was a small statue of the god of seedtime. Braziers of incense discharged greasy coils of smoke which plunged into deeper gloom the temples whose walls were already black with the blood of many victims. In dim corners stood heaps of paraphernalia, conch-shell trumpets, knives, banners, and baskets of shapeless

101.



FARMER STORING CORN FOR WINTER. POTTERY JARS LIKE THOSE SHOWN HERE ARE USED FOR STORAGE TODAY



A FIESTA. HERE A DRUMMER AND SINGERS WITH RATTLES, FLOWERS, AND FEATHER FANS MAKE MERRY



MUSICIANS SINGING A DUET. THE SCROLLS HERE SHOW THE LILT OF SONG. NOTE DETAILS OF DRUM AND RATTLE

human hearts that had not yet been placed upon the braziers. The priests gliding in this murk seemed fitting satellites to the diabolic gods they served. In front of the temple stood the great drum that was soon to throb across the lake the death throes of a nation.

It was from this point that Montezuma showed Cortes his empire, and Bernal Diaz, who witnessed the scene, has left an unforgettable description, which is the best conclusion to this brief sketch of Tenochtitlan, the ancient Mexico City.

"Then Moctezuma took Cortes by the hand and told him to look at his great city and all the other cities that were standing in the water and the many other towns and the land round the lake. . . . So we stood looking about us for that huge and cursed temple stood so high that from

it one could see over everything very well and we saw the three causeways which led into Mexico . . . , and we saw the (aqueduct of) fresh water that comes from Chapultepec which supplies the city and we saw the bridges on the three causeways which were built at certain distances apart . . . and we beheld on the lake a great multitude of canoes, some coming with supplies of food, others returning loaded with cargoes of merchandise, and we saw that from every house of that great city and of all the other cities that were built in the water it was impossible to pass from house to house except by drawbridges which were made of wood,

or in canoes; and we saw in those cities Cues (temples) and oratories like towers and fortresses and all gleaming white, and it was a wonderful thing to behold!"



PRIESTS, MEN, AND WOMEN WITNESSING HUMAN SACRIFICES AT THE SHRINE OF THE WARRIOR GOD HUTZILOPOCHTLI



Mont Pelée and St. Pierre as seen from the Caribbean Sea, 1930

THE VOLCANO MUSEUM ON MONT PELÉE

An American Contribution to the Science of Volcanology

BY CHESTER A. REEDS

Curator of Geology and Fossil Invertebrates, American Museum

WITH PHOTOGRAPHS AND CAPTIONS BY F. A. PERRET, VOLCANOLOGIST

THE 1930 eruption of Mont Pelée on the Island of Martinique, West Indies, has not only reawakened scientific interest in this volcano, but also in the establishment of a research center organized as a museum, observation station, and laboratory at St. Pierre. The one individual, who above all others, is most directly responsible for the establishment of the Musée Vulkanologique de Saint Pierre and its associated endeavors, is the American, Mr. Frank A. Perret. He is the man who camped alone on the edge of the Halemaumau pit of the Kilauea volcano in 1911, and started the work which established the present Hawaiian Volcano Research Association and its station, the Hawaiian Volcano Observatory. This association and observatory has done much under the direction of Dr. T. A. Jaggar to advance our knowledge of volcano activity. Doctor

Jaggar in an address March 31, 1932, refers to Mr. Perret as "the distinguished volcanologist who wrote the great monograph of the Carnegie Institution on *Vesuvius*, who published on the eruption of Teneriffe in the first memoir of Friedlander's *Zeitschrift* in 1914, and who started the work of our association." He also regards him as the founder of modern volcanology from an experimental point of view. It may also be recalled that in the May-June, 1928, issue of *NATURAL HISTORY* Mr. Perret supplied the beautiful pictures for the writer's article "Volcanoes in Action."

Mr. Perret, in addressing a communication to the writer October 31, 1931, said: "All the world remembers the destruction of St. Pierre, in 1902, by a terrific eruption of Mont Pelée. St. Pierre was not only the commercial center of Martinique, but the cultural metropolis of the Lesser



ONE OF FOUR TYPES OF 1930 ERUPTIONS FROM MONT PELÉE

View of eruptive phenomena resulting from a tropical rainfall on the red-hot dome. The steam clouds, which are seen from a distance of five miles, rise several thousand feet above the summit

Antilles. Excavations reveal the exquisite taste of the former inhabitants, and the relics unearthed from time to time are of great beauty, and of interest as showing the effects of the blast of hot gas and ash, which it is useful to study. Those objects, instead of being dispersed as found, should be preserved for all time in a collection, along with photographs of the beautiful ruins, fast disappearing in the rebuilding of the town."

Mr. Perret then refers to the recent eruption of Mt. Pelée and says that the special type of activity of this volcano is almost unique, for the products of eruption are breederust bombs, ash, and lava blocks in new forms. He regards a complete collection of these specimens, placed for comparison with the materials of other volcanoes, and with photographic studies of all their phenomena, as being a scientific necessity.

When notice of the renewed activity of

Mont Pelée reached Mr. Perret, reported to have begun September 16, 1929, he gave up his photographic work and home in Brooklyn and went directly to Martinique. When he reached the island in January, 1930, he found that the volcano had again been in rather violent eruption, that the populace had fled from the north half of the island and was in a furor of excitement concerning the terrors of the volcano and the probable loss of their homes. He climbed the slopes of the volcanic cone to a vantage point where he could see what had transpired. He observed that the Peléan dome of 1903 was deeply caved in from the explosions of September, 1929, and that a new active cone was developing in the center of the cavity. The explosive phases of eruption continued during January and February, 1930. On February 3, 1930, when Mr. Perret saw a new dome arising with castellated towers and slender incandes-

cent lava flows on its sides, he knew from his 1914 observations on the eruptions of Sakurajima in Japan that the more violent phases of the eruption had passed. He assured the populace that there was no danger of a great eruption and that the people who had left their homes in fright might return to them. At first he found that the populace was rather reluctant to return and that for some weeks he was the only resident of St. Pierre. Although the volcano is still active, sufficient time has elapsed to prove that Mr. Perret's predictions regarding the volcano were well founded and true. Consequently, the citizens of that island have a high regard for him and are supporting him in his present endeavor to erect a museum building.

Regarding his own activity Mr. Perret remarks: "I may say that my own work here has resulted in a further demonstration of the practical value of volcanology

as an applied science. Eight million francs of invested capital, depreciated to zero by panic and uncertainty, were restored to par value through diagnosis and prediction based on sound scientific deductions, with the help of apparatus devised for these purposes. For the further development of these methods, the creation of standardized instruments, the bringing together and preserving of the materials, etc., I am now founding at St. Pierre this research center, organized as a museum, observation station, and laboratory.

"It will be a private institution, out of politics, and not governmental; its continuance, after me, is guaranteed by a Fiduciary Committee, consisting of men of the highest standing in the colony, including honorary memberships of the Mayor and Curé of St. Pierre. Its founding has been extraordinarily facilitated by the cession to me of a most ideal site for



ANGULAR BLOCK OF LAVA EJECTED DURING THE 1929-1932 ERUPTIONS

Unequal cooling fractures the mass. The exterior cools rapidly but the interior remains hot for months and crystallizes slowly



DECANTERS FROM THE RUINS OF
OLD ST. PIERRE

A pair of cut glass decanters with the necks melted down by the blast of gas and ash from Mont Pelée which destroyed the town and its 30,000 inhabitants in 1902

its emplacement, on the beautiful Morne d'Orange, 350 feet above the town, but easily accessible, and commanding a superb view over St. Pierre and of the entire massif of the imposing volcano.

"The construction cost is largely covered by local contributions. This is not to be an American institution, but an American contribution to science in a location where this science can be best developed. It is to be a gift to St. Pierre as a continuation of American good will. St. Pierre is visited annually by some thousands of American tourists, whose interest will be quintupled by having a definite goal, where what they most desire to see will be on view.

"The contribution of one thousand dollars, a minimum, makes the donor a founder of the institution, and his name will be placed on a marble tablet at the entrance, and on the stationery of the museum. A few subscriptions are desired, above those already received, when this account will be closed. A total of ten thousand dollars is sought for the foundation.

"This work, at once scientific, artistic, and humanitarian, is believed to accomplish more with a small amount of money than anything heretofore instituted. It

will be self-supporting through its museum, of direct service by its observation work, and world-contributing in its laboratory research."

In regard to the new Peléan dome forming within the 1902-1903 dome it may be noted that Mr. Perret has published two short papers in *Comptes Rendus* 193-1342, 193-1439, 1931, and that Doctor Jaggar has reviewed these papers in "The Volcano Letter" for April 7, 1931. According to these publications the cone-in-cone structure developed by Pelée from dwindling activity of mixed eruptions is a well-known phenomenon, for it has been observed in Vesuvius in the ring of Monte Somma. The formation of a lava dome without a chimney, however, is unusual. The dome in Mont Pelée during January, 1930, was conical in shape, but not in the highest part. The explosions during this period which gave rise to steam-blast cauliflower clouds were from two sources about the new dome: a large one north, and a smaller and higher one southeast. The undermining process produced a horse-shoe-shaped cup with a medial extension. The central ridge was not simple, for castellated groups of towers, round,



A "BREAD CRUST" BOMB FROM
MONT PELÉE

Masses of molten rock are thrown from the volcano into the air. There the surface cools rapidly while the interior remains hot and expands, causing the outer surface to crack



ONE OF MANY ROUNDED BOWLERS OF THE 1929-1932 ERUPTIONS

These huge specimens are carried down the mountain-side in the midst of the avalanches like corks on a river of water. They frequently reach the size of a hundred cubic yards

smooth, and spirally grooved appeared. No doubt, they were tubular, for frequently lava was seen to pour from apertures at the bottom. These towers changed rapidly and on February 3, 1930, consolidated into an enlarged mass with the profile of a true dome. Rudimentary needles formed on the crest. Then came lava activity without explosive ejections which alternated with the cauliflower jets. These rhythmic processes gradually resolved themselves into a regular constructive process, producing numerous needles. The dome grew higher and higher and on February 19, 1930, the summit was flat, but crowned with small needles while the sides were straight talus slopes.

The explanation that has been offered for the formation and thrusting out of needles is the perforating power of gas. A fissure holding magma is opened to the

surface by gases burrowing upward in a row of aligned chimneys. The magma follows, cools in contact with the chimney wall, and the pencil so formed is pushed up. Observations on a few of the needles showed one rising a meter per hour. Pasty magma rose in a collar around the needle, then solidified, when the spine was ten feet high. In another spine the paste was accompanied by gusts of vapor emerging between the spire and the slope of the dome. This needle remained small, but the steam jet continued for several weeks. The average height of spines was from forty to sixty feet. During two months the shell of the dome was so thin and the mass so fluid that the needles overturned on the pasty base.

The new inner dome has left a gulch on the northwest at Petit Bonhomme, while on the east and southeast it has over-



THE RISING DOME OF MONT PELÉE

As seen from the flank of Morne Lénard February 19, 1930. The 1930 dome is the central eminence. It has not yet reached its full height

topped the older dome and ceased activity there except for fumaroles. In September, 1931, the new dome was migrating southwest and the long slope of ejecta was overtopping the ridges there so as to threaten the trail to the summit of the mountain. The new dome is 231 meters (757.68 feet) above Petit Bonhomme and somewhat higher than was the peak of the old dome.

All the hot blasts of gas and ash (*nuée ardente*) emerge from fractures in the old dome of 1902 and mostly from the two openings, low north, and high south-

cast. After the new dome developed, the character of these gushes changed gradually. Four types of downrush are distinguished by Perret. The first is occasioned by an avalanche formed by the squeezing out of a small quantity of magma. It is an imitation of a true hot blast. The magma, not being greatly charged with gas, merely makes a heavy tumble of rocks, which slide down the slope and excavate a trench. Dense, ashy, light-colored cauliflower clouds arise. The second type is occasioned by heavy rain falling on the dome which seems to penetrate it after a quarter hour or more, so as to start ejections of steam charged with dust which descend the slope rapidly as a gaseous emulsion. After heavy precipitation these downblasts are certain to come, and they are important, some of them

in the spring of 1930 following the gorge of the Rivière Blanche and out to sea for several kilometers. The last two types of gushing are avalanches of incandescent blocks without significant dust clouds, and finally a cooler ash phenomenon where blocks of uniform size roll rapidly and far, carrying imperfectly oxidized carbon gases, and emerging from a part of the dome which has partially congealed.

In the southeast part of the new dome there are fumaroles in a horizontal line, due to water, where the old and new domes are in contact beneath. Where the

summit of chilled lava is in contact with active lava, bluish transparent vapor emerges at high temperature.

Mr. Perret has used a microphone for determining the variation in mass of the vibrating active dome. His theory is that an active edifice makes a definite note of lower pitch the greater the mass. The combined roar of slides, blowing of vapor, fall of spines, at any given moment make a musical tone, the timbre of which may be defined in terms of *mi*, *fa*, *sol*, *la si*, etc., so the augmentation or diminution of the dome may be followed. His upper station is on the flank of Pelée at Morne Lénard.

At the beginning of November, 1930, the tone was *si flat*. Three months later the dome was bigger and the tone was deeper, exactly *la*. April 13, 1931, it was *sol sharp*; June 4, *sol*; June 25, a little below *sol*; but on August 10 the pitch had risen to *sol sharp*, and it continued to

become sharper, showing that the mass of the dome was decreasing, and that the arrival of new magma, inside, no longer equalled the loss by slides into the valley, and by erosion.

The work that Mr. Perret is engaged upon at Mont Pelée is of great value to science and humanity. When we look back to the first decade of the Twentieth Century we find a period of geophysical manifestation unequaled in modern times. In 1902 there occurred the catastrophic eruption of Mont Pelée with the destruction of St. Pierre and its 30,000 inhabitants; the simultaneous and even more powerful outbreaks at the Soufriere of St. Vincent and the Santa Maria volcano of Guatemala; the great Vesuvian eruption in 1906; the paroxysms at Stromboli in 1907; the frightful Messina earthquake of 1908 with 150,000 mortality; the Teneriffe eruption in 1909 and the one at Etna in 1910 are out-



MR. PERRET'S FIELD STATION ON MORNE ST. MARTIN

The new dome, which rises above the remnants of the 1902 dome, is here seen in a period of quiet, December 4, 1930



CLEARING THE VOLCANIC ASH OF 1902 FROM THE MUSEUM SITE

The greater depth of ash along the Rue Victor Hugo is due to material heaped up in clearing the street. The original depth of ash was from 20 to 40 centimeters. This site had been a public square. Here were found remnants of a flag, well carbonized but still showing the colors; some carbonized mangoes, a rosary, and some bone fragments

standing examples. The first great explosion at Pelée sent an earthquake wave through the earth to the observatory of Zi-ka-wei, near Shanghai, China, and produced a world-wide magnetic disturbance, which Mr. Perret believes was greater even than the paroxysmal outburst of Krakatao in 1883. The ash of Santa Maria and that of other erupting volcanoes caused yellow sunsets everywhere. Vesuvius blew three hundred feet of its top over the surrounding country. In fact this decade's sum total in loss of human life by volcanic eruptions would probably not be far short of a quarter of a million.

These eruptions called attention to the need for a more intensive study of volcanic phenomena with investigators present at the volcanic sites who could

devote their entire time to continuous observation and research, and who could eventually diagnose the conditions at any center and predict, if not always in advance, at least in the course of an eruption, what might be expected to occur further. In the thirty years that have elapsed since the St. Pierre catastrophe, so much has been done along the lines suggested that it has been possible even at Mont Pelée to reassure the people of Martinique to return to their normal occupations.

A score of the facts derived from this close study of volcanoes during the last twenty years has been summarized in the April 21, 1932, number of *The Volcano Letter* by Doctor Jaggard of the Hawaiian Volcano Observatory, as follows:

THE MAIN MUSEUM
BUILDING

As it appeared in the course of
erection September 30, 1932.
The front faces Rue Victor
Hugo



1. That volcanism everywhere has unity
2. That gas is its prime mover
3. That hydrogen and olivine basalt are fundamental constituents
4. That water is a secondary oxidation product
5. That sulphur is concentrated at craters
6. That engulfment is a common process
7. That explosive eruption is secondary
8. That major earthquakes may be magmatic in origin
9. That magma continually presses upward
10. That cycles are caused by yielding to pressure
11. That this applies equally to earthquakes and volcanoes
12. That small crust units involve short cycles
13. That large crust units involve compound cycles
14. That these may be of several orders
15. That a volcanic cycle may exist at the time of intrusions
16. That intrusions may be studied by tilt and earthquakes
17. That every volcano has intrusions under it
18. That submarine outflow of lava is important
19. That the present is a decadent time in earth volcanism
20. That from Midway to Hawaii and along the volcanic rift, the crust has thickened and condensed.

To those who know the workings of these natural earth forces, volcanic eruptions are explicable. New generations, however, fail to be impressed by past events outside their own experience. In this connection it should be said that modern prediction of volcanic disturbances follows upon diagnosis of conditions, and it is not necessary, though it may be advantageous, to know exactly when an outbreak is to occur.



ARCHITECT'S SKETCH OF THE WEST FAÇADE
Musée Vulcanologique de Saint Pierre, Martinique

An eruption nearly always begins with warning phenomena, and only gradually works up to a catastrophic climax, so that there is time for escape. It is important to be able to know, after an eruption has begun, just what is to follow and when it will be safe to resume ordinary life near a volcano. The prediction of these conditions with modern apparatus and observation by an experienced volcanologist present little difficulty. The work that Mr. Perret is now doing at St. Pierre should be fostered, that we, and the generations to come, may comprehend more fully the nature of volcanic action.

The reconstruction of the building which will house the Musée Vulcanologique de Saint Pierre and its observation station and laboratory was started in October, 1931. It is expected that the building will be ready for occupancy by the end of December, 1932. Prior to the eruption of 1902 the building was a fine villa. At the time St. Pierre was destroyed

it was burned to the first floor, but the walls were well built and are in good condition with all window openings intact. The present plan is to roof over this structure, repair the fresco, and lay a blue tile floor. The floor area is approximately thirty by fifty feet, and the ground floor, as one large hall, will be devoted exclusively to the museum. Eventually the second floor when built will house the observation station, laboratory, and living quarters. Stairs to the upper floor are to be placed outside the building so as to give as much interior space as possible.

The site of the building, which has been donated in perpetuity and rent free, is some three hundred feet above the town of St. Pierre. It commands a magnificent view over the town on the one hand and the volcano Mont Pelée on the other. The site may be reached by footpath and auto road. Mr. Perret, who is directing the reconstruction, will be in charge of the station when it is completed.



A PELÉAN "NUÉE ARDENTE,"
FEBRUARY 9, 1930

This terrible avalanche of ash and hot gas descended the mountain-side at a mile a minute



The Flat-cap Mushroom, *Agaricus placomyces*, Closely Related to the Common "Pink Gill"

MUSHROOMS AND TOADSTOOLS

A Discussion of Some of the Edible and Poisonous Varieties
of the Most Common Forms of Fungi

By CARLOS E. CUMMINGS

Acting Director, Buffalo Museum of Science

FROM time immemorial the toadstool has been associated in the mind of man with pestilence and death. Within its fragile, waxen body it may bear a potency for human destruction as sure and terrible as mortal man can experience. The instinct to crush and stamp, to obliterate the last vestige, is so deep-seated in our natures as to be almost irresistible. The innocent and harmless must suffer with the guilty. Then, too, Nature in the beginning established her law that the toadstool may only live at the expense of other plant tissue. No marble headstone or sculptured monument indicates more surely that something that has lived and perished lies beneath it than does the toadstool, a ghostly emblem of fungus maturity. Some lift their heads with bold effrontery from the very bodies of their perished or dying hosts, while others, as though realizing and feeling ashamed of their destructive character, seek a decaying branch or twig concealed beneath the soil.

Common usage seems to have estab-

lished the word "toadstool" as referring to a poisonous fungus and the word "mushroom" to the edible field agaric, but this custom unfortunately leaves no comprehensive title for the thousands of other varieties which we find around us. Let us, therefore, adopt the more correct usage in which toadstool and mushroom are synonymous, as we must consider many forms besides the two above designated. No one shall claim to know them all by name. New species are continually being discovered and described. Enough for us to learn first the families and genera and leave the specific distinctions until later on. In form we will find no lack of variety. The simple, rounded outlines of the puffball afford a startling contrast to the drooping sprays of the bear's head, and the umbrella-shaped amanita bears little resemblance to the bracket-like polypore. To the esthetic eye their brilliant colors, framed by the soft green of the moss or the more subdued tones of the dead leaves and bark, leave little to be desired, and closer examination



THE COMMON "PINK GILL"

This is well known and widely used for food. It is the only species that lends itself to cultivation with success, and is the one sold in our markets. Most of our canned mushrooms are of this variety

reveals a delicacy of structure that cannot fail to excite the utmost admiration of the student. No flower of the woods displays a more beautiful variety of tint than the lowly russula, and the refulgent splendor of the imperial agaric or the jack o'lantern is hardly surpassed in the vegetable world.

While the entire group of the toadstools are properly classed as plants, they are of a low and primitive order, and essentially different in their structure and habits from the higher forms of vegetable life. In the tissue of the leaf of the tree and blade of the grass lies a marvelous green substance as essential to the life and growth of the plant as the red coloring matter of the blood is to the animal. Under the heat of the sun this green matter grasps the carbon-dioxide of the air, tears it apart, and combines the carbon with moisture, elaborating from these raw materials the sugar, starch, and woody fiber that the plant needs. Bereft of this essential chlorophyl, the

toadstool cannot make, but must borrow, the vital elements of its body. So, needing no heat to effect its physical growth, it may and does flourish far removed from the sun's influence. Fortunately for the forest, few of the toadstools kill their prey, depending on other agencies than themselves to supply their needs. Penetrating between the fibers and cells of the wood, the threadlike mycelium may invade an entire trunk or stump, slowly dissolving and absorbing its tissues until soon the hard wood softens and falls apart, to return as soil to the earth whence it came. Were it not for the tireless and eternal work of the fungus, our woods and forests would soon become choked and killed by the mass of broken branches and fallen leaves which the passage of the seasons develops.

Not only does the study of these lowly forms afford a most pleasurable relaxation and hobby, but considered from a more material standpoint, they may be the means of supplying a most grateful

variety to our daily food. Mushrooms have been collected and consumed for many hundreds of years. The immigrant, fresh from the Old World, cannot comprehend the lack of interest shown by the American farmer who allows tons of delicious food to go to waste on his property year after year. Trained from infancy to distinguish the good from the bad, he selects without fear from the unlimited supply of the wood and field. But here, as always, "a little knowledge is a dangerous thing." Frequently through carelessness or lack of close observation a poisonous variety finds its way into his basket and the call for the doctor is as immediate and urgent as it is often useless. There can be no reason why anyone who is sufficiently intelligent to tell a potato from a turnip should not be able to learn to distinguish a poisonous toadstool. Safety can come only with



THE DEADLY AMANITA, A MATURE SPECIMEN

The white gills are plainly shown, as well as the "death-cup" at the base, and the long, tapering stem. After a little study and experience, there should be no difficulty in recognizing this plant at a glance, even at a distance. It does not always "grow in the woods"



MORELS

No one can mistake the morels, common in the spring. Being hollow, they dry exceedingly well if cut in half, and when soaked in water for a short time, are almost as delicious as when fresh. Their characters are so definite that the beginner may partake without fear

definite knowledge, and this knowledge is far from impossible to acquire, if only the effort be made.

It may not be out of place here to say just a word with reference to the oft-repeated and invariable question as to "how to tell a toadstool from a mushroom." It cannot be too firmly impressed upon the mind of the potential mycophagist that there is no test or rule, and he who trusts in any one of the many and long established but extremely dangerous notions is playing with a frightful death. "The peeling of the cap," the "turning of a silver spoon black," "the flesh changing color when bruised or broken," and the "location in the wood or field where taken," are notions entitled to respect due to venerable age, but are absolutely useless as indications or tests of safety. The characters of a poisonous toadstool are



THE DEADLY AMANITA, ABOUT HALF-DEVELOPED

No plant resembling this should ever be eaten. Note the sticky character of the top, and the cup-like base. The gills and spores are white, and the height of the plant is equal or greater than the width of the cap, in both of which respects it differs from the common edible mushroom

perfectly definite, as easily recognized as a carrot or a beet, and are not determined by any test or sign. Anyone who wishes to enjoy the flavor of a mushroom who is unwilling to spend the time necessary to learn absolutely the poisonous varieties, so that he recognizes them surely with but a portion of the plant before him, may be pardoned for experimenting upon himself personally, but has no reason or excuse for submitting anyone else to his experiments. The price of error in eating fungus is very high. Nature allows but one mistake.

The so-called toadstool or mushroom represents the fruiting body of a low form of plant life. From this fruiting body are distributed, in one way or another, thousands, even millions, of tiny spores, any one of which, under proper conditions, is capable of reproduc-

ing another plant. These spores are of various shapes and sizes and probably not more than one in a million ever develops further. Should conditions be favorable, the tiny spore rapidly grows into the form of a thread and from this thread other threads develop, forming a mass or bundle which is known as the mycelium and is the true plant. This mycelium may grow for weeks or months or years till the time arrives when sufficient tissue and strength can be developed to produce a fruiting body. It is true that a toadstool may "spring up over night," but this springing up can be compared to the opening of a flower bud, both having been preceded by long weeks of growth and development of the plant itself.

In some cases but a single fruiting body develops. These are known as solitary. In others we find them growing in a cluster but quite separate. These are known as gregarious forms. The word



A GREAT FAVORITE FOR THE TABLE

The oyster *Pleurotus* is very common and easily identified. It should be gathered when fresh and white, and be carefully and thoroughly cooked



HYDNUMS

The hydnums are among the most striking and attractive fungi, and may reach a considerable size. Skillfully browned in butter this species resembles a broiled lobster in texture and flavor

“caespitose” is applied where a large number appear growing close together, the stems being joined at the base. In this connection we may note the “fairy ring,” which for so long defied explanation. A circle of deeper green on the grass of the lawn, surrounded by a ring of toadstools, suggested the popular name, it being believed that the fairies came here and danced in the moonlight. Science, however, offers a simpler explanation. Starting from a single spot, the plant spreads through the soil in every direction, increasing in size year after year, and as the toadstools develop from the edges of the growth, just as the fruit appears on the ends of the branches of the tree, the circular form or ring of fungus appears.

The sole purpose of this fruiting body is to produce spores. That this may be accomplished, Nature folds and shapes

the fruiting surface in a curious fashion. In the agarics the under surface is pleated into gills, while the boleti and polypores have a surface indented in the form of a honeycomb. In the puffballs the entire structure turns into a mass of spores which are set free by the breaking of the skin, or discharged through a mouth. We cannot take the space here to describe the marvelous structures on which the spores are developed, but a very interesting demonstration can be observed by anyone who will take the trouble to place the cap of a toadstool on a piece of white paper with the spore surface down. At the end of a few hours a wonderful pattern of white, red, brown, purple, or black can be seen on the paper where these tiny bodies have fallen and collected in masses sufficiently dense to be visible to the eye. In the ink caps the entire body of the



GEASTERS

These are really puffballs with the outer coat turned back, resembling the petals of a flower. Note the dark apical mouth from which the spores are discharged

toadstool becomes liquid and the spores are borne to the ground in a mass of black slime. The stinkhorn bursts the shell in which it develops, surrounded by a thick layer of gelatinous, semi-liquid matter, and lifts into the air to a distance of several inches a red or dark-olive cap which is covered with a thick layer of spores, mixed in a sticky solution. This substance in a few hours develops a most disgusting and overwhelming odor, plainly perceptible many feet away, and to this carrion feast are attracted thousands of flies, who carry away with them and distribute the tiny germs of the plant. The fragrance of the apple blossom attracts the bee, the stench of the stinkhorn is as pleasing to the fly, but who shall explain the purpose of Nature in establishing in the gills of the yellow *clitocybe* its wonderful phosphorescent character, glowing in the woods at night like a will-o-the-wisp and illuminating its surroundings with an uncanny, soft blue light?

The bending and turning of the stem of the plant so that the green leaf may receive its greatest portion of sunlight, is a phenomenon well known to every one, and while the toadstool, as has been stated, does not depend on the heat of the sun to effect its growth and development, nevertheless we find a most interesting pecu-

liarity and movement, but for a very different purpose. Where the spores are developed from gills or tubes, the force of gravity is utilized that they may fall away without obstruction and so, in some marvelous fashion, the stem of the plant

invariably bends or turns during growth, so that the gill or pore surface is vertical to the ground. Whether growing from the surface of the earth or emerging from the upturned trunk of a tree, the cap will invariably be found in a horizontal position when the spores are ripe. If the young plant emerges from the under side of a tree, we oftentimes find the stem bent in a complete turn. In the *amanita* the stem grows in an upright position, the cap being placed squarely across the top, but if this plant be gathered and laid on its side in the basket, we will find that very promptly, almost as we watch it, the stem will bend itself so that the gills will be upright. For photographing in the laboratory, it is very important that these forms be carried from their native soil without altering the position in which they grew.

Having left the mother plant, the spores are lifted by the wind and currents of air and carried for long distances until finally they come to rest, and such as are fortunate enough to find a lodging in a suitable food supply under proper conditions of temperature and moisture, pursue their growth into the perfect plant. The exact life history of the spore is not definitely known and undoubtedly varies with the different species. Much re-

mains to be done by observation along this line. The theory that certain forms are assisted in their growth by passage through the body of some insect or animal is of great interest and undoubtedly true in many cases. The common mushroom is found most abundantly in pastures which have been frequented by sheep and cattle. Not only is the mushroom a favorite food for man, but a host of other creatures, both large and small, have discovered its succulent qualities. The collector must be very promptly on the spot if he wishes to find his specimens in perfect condition. Snails and slugs consume great numbers and turtles and grazing animals do not fail to get their share. Possibly the greatest destruction in both the wild and cultivated species is brought about by mites and fungus gnats. In some marvelous fashion the mother insect detects the tiny plant, possibly before it has reached the surface, and deposits a large number of



PUFFBALLS

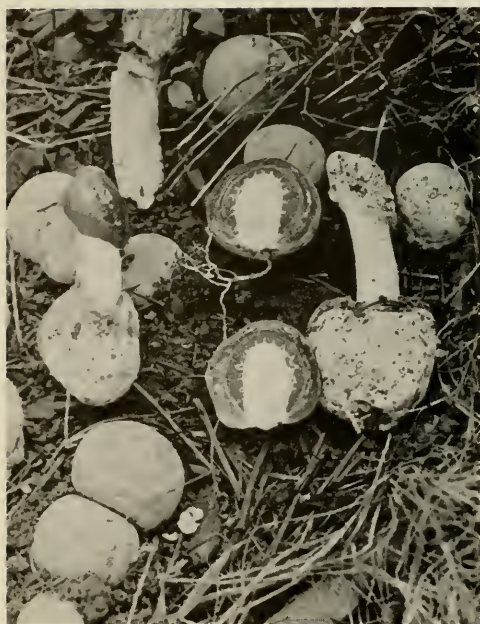
While all puffballs bear a good reputation, Doctor Cummings personally has had no experience with the smaller varieties as food. They should be used only while fresh, when the flesh is firm, hard, and brittle



THE SULPHUR POLYPORE

Thus takes its name from the characteristic color of the pore surface. Its formidable appearance does not indicate any poisonous qualities, as it is a prime favorite among experienced mycophagists, if gathered while young and tender

eggs. Hatching quickly, the young burrow up through the stem, perforating it with their burrows, finally pervading the cap. Many a succulent form, apparently perfect, will be found completely riddled when cut, and of course, unfit for human food. Last summer the writer carried home a splendid specimen of the *fistulina* or beef tongue. In order to prepare it for the table it was cut in two, and at the first touch of the knife from the spore surface suddenly appeared what seemed to be a white cloud rising several inches, and as suddenly disappearing. Investigation showed that the pores of the fungus had been occupied by an incredible number of tiny spring-tails which, startled from their retreat, had sprung simultaneously into the air, and the suggestion that those that remained would give an additional meaty flavor to the cooked fungus was not appreciated by the housewife.



STINKHORNS

The "egg" or young plant shown in the picture is one of the most puzzling objects for the young naturalist, but when grown to the mature stage there is no difficulty—the smell alone would be sufficient

Very few people are unfamiliar with the ordinary meadow mushroom and to most palates its flavor is very attractive. For many years mushrooms were considered equivalent in food value to meat, as chemical analysis demonstrated practically the same elements. Recent investigations, however, have proven that chemical analysis is not always an indication of food value, and it has been shown quite conclusively that the attractive flavor of the mushroom is its principal recommenda-

DISTANT-GILLED
LACTARIUS

The *Lactarius* group exude a milky juice when bruised. Some of them are intensely peppery to the taste, others most agreeable even when eaten raw

tion as an article of diet. Its flesh may replace in bulk more expensive meat but it lacks the vital principles, or "vitamines" which have recently been proven to be essential to assimilation and growth, and a person could starve to death on a mushroom diet, although theoretically all the elements of food might be present.

The poisonous forms may be grouped into two classes, both of which are included in a single genus of plants, the amanitas. Most deadly of all is the one known as *Amanita phalloides*, or "destroying angel" to which science has added a number of subspecies. This group is characterized by white spores, and all grow from a cuplike body underneath the soil, which is known by the popular name of "death cup." The members of this group contain one of the most deadly poisons known to science and one which, in its ability to torture and kill, knows no rival. From six to fifteen hours after eating, no symptoms or indications are evident. This period is followed by one of extreme gastro-intestinal disturbance accompanied by great thirst. Then come delirium and convulsions with cramps of the muscles, finally coma and death. The symptoms resemble closely those of cholera and there is no remedy known of



the slightest value in this poisoning. The appearance of the symptoms is an indication that the poisonous material has been digested and absorbed into the blood, and no treatment can be made effective. The poisonous principle has been named the "amanita toxin," but has not been chemically determined. Dogs and cats are poisoned by the cooked fungus and the symptoms are the same as in man, and it may be of interest to note here that a leading writer on this subject suggests as a good method of testing mushrooms that they be "cooked and fed to the cat."

The poisonous principle of the second class is muscarin, which takes its name from the fly amanita or *Amanita muscaria*, although it is found in several other species. Muscarin has been determined chemically and even produced artificially in the laboratory. The symptoms of poisoning by this agent afford a characteristic picture, appearing in from one-half to three hours, and exhibit disturbances of the stomach and intestines, a slow pulse, dizziness, and hallucinations. If a sufficient quantity has been taken, delirium, convulsions, and death follow. The drug known as atropin or belladonna has been found to be an exact physiological antidote, and if administered early



INK CAPS

In spite of their disgusting appearance when old, by reason of their liquefying gills, ink caps rank among the most digestible of all fungi, and sometimes will be retained when all other foods fail

in sufficient quantities, may counteract the effect of the poison. It is a rather remarkable fact that the fly amanita is used in some countries as a means of producing intoxication, but we are told that the headache which follows a muscaria debauch is of a type far beyond anything known from any other agent.

Strange to say, some of the amanitas very closely related to those previously mentioned are not only free from poison but are very eagerly sought by

THE BLUSHER

Another member of the Amanita family. When handled or bruised, it changes to a reddish tint, although some specimens are normally of that color. It can be eaten, but possibly good advice is "don't do it"





TWO FINE EXAMPLES OF THE POISONOUS "FLY AMANITA"

The one to the left is fully developed. The bright orange cap is spotted with wartlike fragments of the volva. Soaked in water, with sugar added, it furnished a fly poison to our grandmothers, hence its common name

the mushroom connoisseur. The orange amanita was so much in demand in historic

times that it was called the imperial mushroom or the "mushroom of the Caesars." We are told that, when served, plebeian hands were not permitted to touch this fungus but that it was prepared by the master himself in vessels of gold and silver. In 1896 the Count de Vecchi and a number of his friends died in Washington from having mistaken the fly amanita for Caesar's mushroom. It seems rather strange that anyone could have mistaken these two species, for they resemble each other only superficially. While both are orange colored, Caesar's mushroom has no warts on the top and grows from a cup of the most conspicuous character, while muscaria shows very well developed spots on the caps and springs from a cup which is hardly more than a bulbous base. The gills of Caesarea are yellow, those of the poisonous muscaria, white. The "blusher," another member of the amanita family, is used for food. There should be little difficulty in determining this species, as its flesh, on being bruised, exhibits a reddening conspicuous enough



BIRD'S NEST FUNGI

These are too small and infrequently found to be of any interest to the mushroom eater. Yet they are strange and interesting plants. The spores are developed in the little "eggs" at the bottom of the cup

to have occasioned its popular name. However, the novice should leave the entire amanita group severely alone as far as food is concerned. Their characters should be thoroughly and carefully learned, so that they may not find their way into the basket. There are too many safe forms to make it worth while to experiment with this dangerous family. The puffballs are all edible, but become bitter as soon as the white color of the flesh begins to darken. The inkcaps, particularly the shaggy variety, enjoy a reputation for edibility and innocuousness second to none, and their deliquescent character makes it almost impossible to mistake them. The beef tongue is excellent and often eaten raw as a salad, and happy is the collector who discovers a splendid growth of the sulphur polypore, easily recognized by the brilliant sulphur-yellow of the under parts. This fungus is perfectly safe and a single find will afford ample food for a large family. It must be used while young,



THE DECEIVING CLITOCYBE

While not actually poisonous, it makes most people sick who eat it. It glows in the dark with a soft blue light, and a cluster gives off enough heat to be plainly perceptible to the hand

as older specimens become very tough.

The morels are characteristic in appear-



THE IMPERIAL AGARIC, OR MUSHROOM OF THE CAESARS

A member of the Amanita family. The top is bright red, changing to yellow, with striated margins. The gills are yellow. Note the very conspicuous egg-shaped cup from which the plant springs. The flavor is strong but attractive—but great care must be taken not to mistake the poisonous “fly Amanita” for Caesarea



THE CATERPILLAR FUNGUS
CORDYCEPS MILITARIS

We have all heard of caterpillars eating plants; here we have a plant eating a caterpillar. The portion above the ground is bright orange in color

ance and all are both delicious and perfectly safe. They appear in the spring, and sometimes grow so abundantly that a bushel or more can be collected. They dry perfectly, and can be freshened for use by a short soaking in water.

There is no doubt that the poisonous character of fungi varies with the season and to a certain extent with the locality. Authorities do not always agree as to the results of eating certain forms. Then, too, the question of personal idiosyncrasy enters, precisely as with many other foods, some people eating without discomfort substances which in others produce unpleasant if not serious results. It must not be inferred that all toadstools which are not poisonous are edible. There is no more apparently delicious and attractive looking fungus in the woods than the big brown boletus, its top resembling a newly baked cake, and with flesh firm, white, and pleasing to the eye. No one, however, would make more than one attempt to eat it, as its scientific name, *felleus* (gall), gives but very slight indication of its extreme bitterness.

Anyone who heedlessly experiments with the peppery *lactarius* will undoubtedly consider one experiment sufficient, as a single drop of its milky juice applied to the tongue gives an effect which can be compared only to the sensation produced by a red-hot needle. Other forms, among which may be mentioned the deceiving *clitocybe* and the emetic *russula*, while not deadly, are not tolerated within the body, and, if eaten, are promptly ejected by the exasperated stomach. It is hardly necessary to add that toadstools for food should be *reasonably* free from worms and should be consumed promptly after being gathered, as many harmless forms readily decompose into a noxious condition. There are also records of people having been made ill by consuming stews which, while harmless when freshly made, had apparently developed a poisonous character on standing over night.

Space will not permit a discussion here of the systems of classification and identification which are in use today. While the literature on the subject is a long way from complete, nevertheless there are



THE HONEY-COLORED ARMILLARIA

Very common, especially around stumps, where it may grow in enormous clusters. While not considered a particularly desirable food, it is nevertheless consumed in large quantities



THE GIANT PUFFBALL

Sliced and fried, with possibly a coating of beaten egg to hold them together, these have been compared to sweetbreads, calves' brains, and other similar delicacies

many good books. Among these McIlvain's *One Thousand American Fungi*, ranks as standard. For the beginner the *Mushroom Book* by Marshall, *Mushrooms* by Professor Atkinson, and *Edible Mushrooms* by William Hamilton Gibson, are of great interest. *The Agarics of Michigan*, a technical report by Doctor Kauffman, is of great value to the advanced student, and there are innumerable reports of scientific societies which are available in the libraries. It is unfortunate that Hard's *Mushrooms Edible and Otherwise*, is out of print and not available, as this writer combines accuracy of description with popular language to a fascinating degree and his photographs are of the utmost value. Classification is based on the color and character of the spores, the arrangement of the gills, and the presence or absence of a cup at the bottom and an annulus or ring about the stem.

It is to be regretted that the fragile and evanescent character of these plants makes it rather difficult to prepare a collection of specimens. Some of them, it is true, can be dried and preserved in this form, but they invariably change and lose their color, and these dessicated mummies

fall far short of conveying a definite idea of the living plant. A great majority of them decay and become very offensive. It might be possible to preserve the structure, if not the color, of the specimens in formalin or alcohol, but this would necessitate glass jars and storage space, and it is at best a mussy and unsatisfactory method. It is surprising how few workers have devoted much time to mushroom photography, compared to other branches of science. It is not a particularly difficult line of work, as the plant usually remains free from movements or vibration sufficiently long for satisfactory time exposures to be made. As their natural habitat is usually away from the direct rays of the sun, time exposures are almost always necessary. An ordinary plate camera with a tripod is best for this work, and as most of them must be photographed at very short range, a swing-back is essential. Use a stop not greater than F-16 and expose sufficiently to get fully timed plates. This may necessitate from twenty seconds to a minute, but it is very seldom that this exposure cannot be given without serious difficulty.



A Typical Naga Village, Hemmed in by Jungle

JUNGLE PEOPLE OF ASSAM

Customs and Ceremonials of the Nagas, a Fierce Race of People That Dwell
in the Hills of British India

By C. SUYDAM CUTTING

IN the hills of northeastern Assam lives an extremely interesting race of jungle people called the Nagas. The members of this race have slightly Mongolian characteristics but are quite unique in comparison with adjacent peoples of a similar strain. As the Nagas have no written language and no folk lore, nothing definite can be determined with regard to their origin. The advent into their present home must have been from somewhere in the north or east, as the plains to the south have always been occupied by the ancient kindgom of Assam on the southwest and the Shans on the south. Their logical route of progression would have been from the east via North Burma, thus avoiding crossing any part of the high Tibetan plateau. Coming down to the plains of Assam in the Bramaputra valley, they must have found the country occupied and strongly held by the Assam kings, so that a return to the hills where they are now would have been necessary.

In common with most hill tribes, they are fiercely hostile to strangers. Next to self-preservation and reproduction, head-hunting is their great occupation, and the hills bordering the Assam valley

are eminently adapted for raids. The valley is now governed as one of the presidencies of British India. The native population is mostly Assamese—a lazy, indolent, unwarlike people very different from the virile Nagas. Raid after raid for the coveted head trophies would be made at night on these valley dwellers with the British almost powerless to prevent them. Finally, by warfare carried on with Indian Army troops, the bordering sections of the Naga Hills were conquered and administered by the Government. This hill area now acts as a buffer between the Assam valley and the unadministered country out beyond in the blue.

Head-hunting, however, continued, for the helpless Assamese were too great a prize, but the raids became much less frequent as time went on. Serious raids were sometimes followed by effective punitive expeditions against the raiders, to teach them that head-hunting of British subjects was definitely forbidden. Today the administered area of the Naga Hills is under complete control. A district commissioner and his subdivisional officer govern the tribes excellently. A head

man is appointed for each village, who is responsible to the government for his domain. Kohima is the capital of the administered area—a small post at an altitude of about 5000 feet—and is connected with the railway by a good military road cut through the jungle for forty miles.

The Nagas are subdivided into several tribes. These various tribes bear similar physical characteristics, yet can be readily distinguished by the variation in their clothes. The Nagas themselves are a very fine racial type. Light brown in color, with clean-cut faces only slightly mongoloid, tall and slender, they are extremely good looking. They suffer little from disease, which may be due to their living in a higher, healthier atmosphere than that of the low-lying plains. They seem to embody the characteristics so common to all hill tribes. All are strong and vigorous, with no trace of laziness. They have the most excellent sense of humor, which is

openly displayed at all times. In fearlessness they are second to none.

In the administered area, fighting among themselves has been completely stopped, but in the unadministered area it is sometimes rampant. As mentioned, head-hunting is continually carried on. In all the areas, both administered and non-administered, the villages of the tribes are near one another, and jungle trails wind in and out between them. Where the Indian Government has sway, friendship seems to exist between all villages and tribes. Elsewhere the situation is one of bitter and continuous enmity. Adjacent villages, whether of the same tribe or not, have their hands forever turned against each other. Indeed so great is the probability of raids, that they are fortified like armed camps.

Like those of all hill tribes, the villages are set along the ridges and, in the case of the larger ones, are composed of an in-



WOMEN OF THE AO NAGAS

The Nagas are subdivided into several tribes, each of which has its own language, and even separate villages of one tribe may have different dialects

tricate network of small streets. The jungle, which is as dense as a true tropical one, hems in the villages on all sides. The houses are circular and covered with thatch and rattan leaves to make them completely waterproof during the heavy monsoon rains. They are all jammed very close to one another along the narrow, dusty streets. Each village usually has one open, flat space, which takes the place of a sort of community ground where the inhabitants meet at ceremonial times. By our standards none of these villages could be called clean, and though the natives themselves distinctly are so, every spot is flea ridden. The general altitude of the inhabited ridges runs from about 3000 to 7000 feet.

All the Nagas have the same food and drink. Rice is their main staple, and two types of terrain are used for growing it,—hillsides right near their houses which must be terraced, and the valleys below. The former system is complicated, as it must require an infinite amount of labor to level off the vast number of small terraces to get sufficient area to plant their paddy. Also careful irrigation must be devised that the crops may mature properly. In the valleys, irrigation is much easier but these latter fields have the disadvantage of being far away. Here, when there is much work to do, the natives build temporary shelters so that they need not go back and forth from their homes on active working

days. Besides using rice as food, they also distil a drink from it which they consume in enormous quantities. This drink is very mildly alcoholic, perhaps containing from 1 to 2 per cent, and they drink it out of huge cups made of rattan leaves, the horns of cattle, or sections of large female bamboo. During ceremonial times they drink it more or less all day and succeed in getting themselves quite intoxicated. Everyone drinks it, old and young alike. Those who show the least moderation are the older and more important men of the community.

For meat, of which the Nagas are extremely fond, they have native pig and ox called "mitten," both domesticated. The boars are enclosed, but the sows run everywhere about the village and the near-by jungle. Dog meat also is very popular. The pigs, together with the native pariah

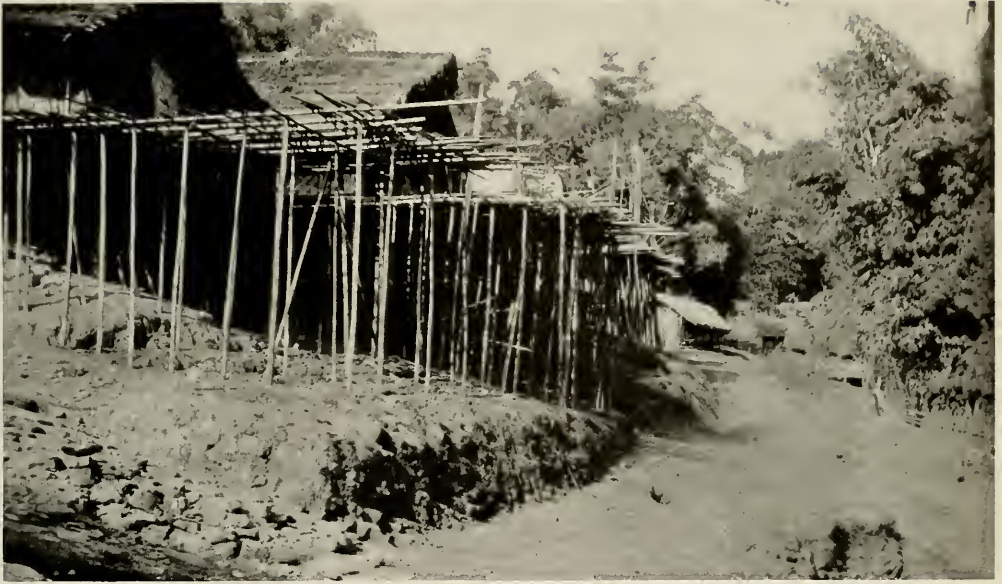
dogs, form the only scavengers of the villages. The pigs are a great delicacy, and although their meat is much more rarely eaten than rice, it forms a staple with the rice beer for ceremonial feasts. Except for plain rice, Naga food would be nauseating to a European. The rice beer is insipid and fairly unpalatable. The pig meat has a high, unattractive odor due to the filth the animal eats, and the rice often has wasp grubs mixed with it.



KONIAK YOUTHS

Note the bead necklaces and the very tightly drawn belts

The chickens which the natives have for sale are like any native chickens of India. They do not seem to favor this fowl as they do their pig, but it is a saving grace



A VILLAGE STREET

The flimsy houses are constructed very close together along the narrow, dusty street

for the visitor. As a matter of fact, to a stranger, Nagas appear to be willing to eat anything. One may be walking along a dry stream bed with them, when a native suddenly will lean down and overturn a stone on the bottom. Underneath there will be a large, long-legged, wriggling insect. This he will put, alive and very active, into his mouth. One species they particularly like is what we might rightfully call a "stink bug" because of its disgusting odor.

As for head-hunting, this is practiced because of the great value set upon such trophies by their possessors. Heads are passed on by heredity and are kept forever in a sort of "skullery" in the rear of the houses. A fine skullery gives great prestige to a man because of the glory of his ancestors who contributed to the collection, and those which he acquired himself. Heads are distinctly classified in value. The most prized is that of a baby or young child; then that of a woman; and, lastly, that of a man. The reason for this is clear. A Naga will never take the head of an inmate of his

own village, so he must look to another for his prize and this will always entail danger. A man's head is the easiest to acquire as he must continually be away from his village either hunting or tending his paddy fields. A man may be killed by either stalk or ambush with good chance of a get-away. Not so with a woman, who is usually in the village or near its immediate confines. To get her head is very dangerous work indeed, as the killer runs great risk of being seen or apprehended by others of the village and dire will be the consequences if he is caught. As for a baby, one must not only enter a village to procure one but, usually, right into a house itself. No wonder the latter as a trophy is highly prized. As a result, a woman's or child's head in any skullery is comparatively rare. Those who aspire to one make their plans carefully, and only enter a village after they have long watched it and noted that practically all the men have left. Even then there is danger. Mention has been made of the network of streets. With these the stranger is entirely un-



AO WOMAN WEAVING CLOTH

Weaving is one of the arts practiced by the Naga women, each tribe manufacturing its own material

If things are not promising, this ceremony may take the form of a human sacrifice, as it is considered that these have the greatest appeal. It is quite immaterial to the Nagas who is used for the sacrifice provided the specimen is alive, so a slave is chosen and generally an old female—a worn out one. Should they not have such a person in the village, they may apply to a neighboring one

and, if procurable, buy the old woman. Killing is always done the same way, chopping off the head with the “dows,” or long metal jungle knives.

familiar, and great care must be taken, should he be apprehended, that in trying to escape at a dead run, he takes no wrong turn that will lead him into a cul-de-sac. The District Commissioner knew of such a case where a man, vainly endeavoring to escape, was finally boxed and caught red-handed with the head in his hand.

Each Naga tribe has its own language, even separate villages of one tribe may have different dialects. They never have had any form of writing and their religion is simple nature worship. Nature worship and devil worship are practically the same. The underlying principle of it all is that one makes special provision to guard against the action of evil spirits who harm man. The good spirits cause only conditions of normalcy and therefore do not come so much to the attention of the people. They are consequently more or less disregarded. The evils that attend Nagas are the usual ones among all primitive tribes. A poor rainy season is the foremost one. Others may be numerous, such as flood, danger from tiger to their cattle, (of the latter there are few), stream crossings which may be unsafe during the rains, etc., etc. The Nagas are very fond of amulets, which they wear suspended from their necks. The most important ceremony is the one for rain.

It is not uncommon for rich men to inaugurate ceremonies for themselves and to pay all the expenses. These are designed solely for their own aggrandizement. A most popular one of this kind is that of pulling a big stone. The cere-



READY FOR THE DANCE

Ceremonial costumes for tribal dances are very elaborate. Each tribe has its own type of dance

MAKING POTTERY

Pottery is made by just one tribe, and it is done without the aid of a potter's wheel



mony lasts at least two days, and its finale is the pulling of the stone itself. During the ceremonial days no work is done. All the villagers congregate about what corresponds to the village square, and feasting is the order of the day. The rich man who is running the show, will have ample pig for everyone to eat and vast quantities of the rice beer. Sports of a very simple type such as wrestling, etc., are indulged in by the young men, and organized tribal dancing may take place. It is a period of festivity and joy. Carefree, they walk about or sit in groups, all, even the children, holding their cups of rice beer.

The final stage takes place in the afternoon of the last day. A large stone has already been chosen about a mile or so from the village. All the men and boys

adjourn to this spot and harness themselves by rattan ropes to a platform on which the stone has been placed. Once they are prepared for the pulling, the Nagas are stretched out in a long, thin line. This is necessary because of the narrowness of the trail. If the stone is a heavy one, very great effort and very slow progress will be the result. The stone itself is not dragged into the village, for there is no room there to accommodate a lot of these, but it finally comes to rest somewhere on the trail after about a mile of dragging. Here it remains as a testimonial of glory and honor to the author of the whole affair. The heavier the stone and the finer and longer the feast, the greater the honor.

One curious ultrapagan custom of the Nagas, is official and organized cursing. At one time a little girl, while working in the fields in the administered area, was killed for the beads she wore on her neck. This was all that could be taken, as in this area head-hunting was forbidden and such a trophy lying about would bring quick retribution from the government. The girl was killed in a paddy field between two villages, but no one could find the culprits and investigations by the District Commissioner bore absolutely no fruit. The inhabitants of both villages were in



SINGING AS THEY DANCE

Much ceremony and enthusiasm are injected into the tribal dances performed by the Nagas

sympathy with the District Commissioner and, to help him, they decided to have a cursing, which plan the District Commissioner heartily endorsed and, furthermore, possibly to make it more effective, he agreed to take part in it. He told the Nagas that his father and grandfather had been great cursers and that he had inherited the talent. Three months before, when angered at a certain village, he had prophesied that it would burn down as a retribution. It did burn down. Villages frequently burn down and are readily rebuilt, but he felt his stock, as prophesier or curser, was high.

About eleven o'clock in the morning, the Nagas from both villages, and with all the men armed with spears, came in separate groups to where the District Commissioner was staying. The latter started the ceremony himself, observing all the correct pagan customs of this particular rite. First he built a circular trench, which was then filled with water. This trench enclosed the spirits so that they could not

get out. Then came the incantation in which he recited a part of the *Illiad* and a part of the *Odyssey*. Anything they could not understand was sufficient. When this was over, he broke an egg on the ground and opened the trench to let out the spirits. All this was according to rote. His curse was over and it was time for the Nagas to do theirs.

Properly to understand all this, it is necessary to realize that the curse was directed to the one or more culprits who must have been present in the watching throng. For them to have stayed away from the ceremony would have been a sure admission of guilt. Each village group then in turn took up a chant, and a weird and ghastly one it was. Slowly, in a rising crescendo, it advanced. The tone and the expression on their faces were of bitter, ferocious hate. As it ended with almost wild cries, the effect was more than awe-inspiring,—it was blood-curdling. An effigy in bamboo had been put up to represent the culprits, and each village group, having finished their awful curse, hurled their spears at it. Then they all returned to their villages.

The District Commissioner had been carefully scanning the faces of the men to try to recognize any sign of guilt. All had been cursing, so the guilty must have been cursing themselves. He seemed to have found no conclusive signs but was, however, well pleased. "The cursing has had its effect," he said, "the guilty will probably be dead in a week's time"; and this was more than likely a true conjecture.

One other very common rite that is practiced by all the Naga tribes is that of dancing. This is always ceremonial, and very elaborate clothes are worn on these occasions. Each tribe has its own type of dance, and the women, if they do dance, do so separately. They all seem very fond of it and take part in it all the time; in fact, it is their chief ceremonial expression. These dances are very active



ELABORATELY DECORATED KONIAKS

Clothing, while it is worn by the Nagas in the administered area, is very scanty and is reduced to a breech clout during the hotter hours of the day

and are often accompanied by singing. Nagas also believe in soothsayers, each village having one or more. These are consulted when any important decision has to be made. Their methods of divination are not the same. Two different types were seen, one making an incantation with an egg and another reaching his conclusions by the way particles of wood fell when chipped off a stick.

In the administered area, all the Nagas wear clothes. These are fairly scanty and, during the hotter hours of the day, they may wear nothing but a breech clout. In the unadministered area, it is not uncommon among some tribes for both sexes to wear no clothes at all. Some ornaments in the form of beads have filtered in from India and are worn on all occasions. Of implements they have few, just their bamboo containers, wooden bowls, and long knives in the form of a very heavy machete. Pottery is made by only one tribe and that without the use of a potter's wheel. All manufacture their own cloth.

Burial of the dead among Nagas varies. In some cases the body is placed in a sort of oval coffin open at the top. This is suspended just below the rafters in the house where the family is living. A small fire is then started and kept burning till its gentle heat has entirely dessicated the body. This process takes over a month. In the bottom of the coffin there is a hole through which any fatty liquids of the body can run out. Eventually, after having been in the house for months, the body is taken down and broken up. Thereafter an examination of it is made and, if any bones remain whole, they are preserved forever in a box which is kept in the house. The rest is just tossed over a cliff. Another method of burial is to place the body on a raised platform where it is stretched out and covered over.

During our trip, the District Commis-



PULLING THE BIG STONE

A popular form of public entertainment by the wealthy for acquiring glory in the community

sioner was anxious to collect a few skulls for the Pitt River Museum of Oxford University. These were to be used as anthropological specimens. He could not get them from local skulleries as such trophies were too valuable and the owners loath to part with them. Consequently, graves had to be robbed. He hired a native to do this secretly at night and told him he would receive ten rupees for each head. The man was given to understand thoroughly that he was to be entirely on his own. If, during his nefarious work, he should be apprehended, the District Commissioner would not only give him no support but would hotly deny any knowledge of the affair. The first and second nights he brought in a head and then he lost his nerve and refused to go on with the work.

When traveling with Nagas, one thing is quite impressive about them, and that is that they appear to walk up long, steep hills as easily as on the level. This is due to their having always lived in an intensely hilly country. Their main trails

run between villages along the ridges, but they have innumerable short cuts which always lead them straight down a long way and then straight up again. There are no pack animals in the country, as the trails are unsuited for their use, so that all packs are carried in long, waterproof baskets on their backs. When on trail, even when loaded, they will always choose the more tiring short cuts to save just a mile or so, as compared to the longer routes along the ridge crests.

Some of the tribes have a sort of communal house in each village that acts as the men's club. Here the men congregate at certain intervals, and the boys who have reached the age of puberty but are unmarried, live permanently in these houses until their marriage. During this period, the boys are taught religious rites, tribal customs, and particularly the art of war.

During my stay in this country, a small punitive expedition was formed for purposes such as were mentioned earlier. The four whites who went along were the District Commissioner, his subdivisional officer, an infantry captain of the Indian Army, and myself; there also were fifty native troops, our personal servants, and a native army doctor. Nagas fifty strong who lived in the administered area took our loads for the first march and having deposited them near a native village over the border, started back home. From there on, our porters had to

be recruited from the enemy. The plans, as prearranged, were to lecture the head men of the villages, in general, with regard to not taking any more Assamese heads in the valley, and to impose fines on them and take a few prisoners. For this reason our camp was always placed in the proximity of some village. It was usual to find, on arriving, that news of our coming had, naturally, long preceded us, and that practically all the natives, being afraid of us, had absconded into the jungle. They would remove what valuables they could take and hide their pigs. One or more head men always remained and these were interviewed shortly after arrival.

The day's march was usually not protracted beyond noon or one o'clock, as it took most of the afternoon to prepare our camp. As we were in a hostile country,

proper defenses against any possible night attack had to be prepared. If there was no natural clearing, the jungle had to be cut away. Camp was generally oval and surrounded with a regular chevaux-de-frise made of sharpened pieces of split bamboo, all the ends pointing aggressively outward. Then our tents had to be put up and the men's quarters all made of bamboo with rat-tan leaves on the roof to keep them waterproof.



TROPHIES OF THE HUNT

The spoils of head-hunting expeditions are mounted in skull-racks on the premises of the collector, and are held as hereditary possessions of great value

Every afternoon negotiations had to be entered into with the head men to arrange for our next day's porters. Although most of the inhabitants were absent, their



AN AO MEN'S CLUB

A communal house in the village is set aside by some tribes as a meeting place for the men and as living quarters for the older boys who remain there until they marry

location was well known to the head men. These porters were vital, as our troops could not carry loads on trail and be prepared to resist a surprise attack from ambush. There was always one standard threat should our new porters not arrive in the morning and that was that we would immediately set their village in flames. This was no idle boast and the head men knew it, so never did our porters fail to turn up. These were paid in rupees if they could use it, otherwise in red cloth. No Nagas have any currency of their own and all trade is carried on by barter.

A day's march would start about eight o'clock. The porters were all placed in the center of our long, thin column, with soldiers as guards interspaced among them. The remaining soldiers were divided into advance and rear guard, all with drawn bayonets. When we drew near to our next camp, all the porters were sent back. Every village is a little fortress and an enemy to every other. It would have been unfair to any one village

to bring up, under our protection, men from another village, as it would give the latter an opportunity to study the defenses and possibly partly destroy them.

As the trail approached a village, its sides became irregularly lined with small pot holes with a piece of sharpened bamboo sticking up from their bottoms. Often did we see our porters destroy these with the dows, as they form an excellent defense against night attack. All Nagas go barefooted and a wound from such a defense would be crippling.

Meetings between the head men of a village would be in the village itself. When going to these meetings or anywhere outside our camp enclosure, a small guard always accompanied us.

Just before sundown came our last performance of the day; this was a drill for repelling attacks. All our fifty troops took their allotted positions, crouching behind the barricade; then the whistle blew and all but the night guard returned to their enclosures. At this time all



FORTIFIED CAMP IN THE
KONTAK AREA

Every possible precaution had to be taken to be prepared for surprise night attacks from neighboring enemy tribes

side, the enemy having no rifles, as many casualties might have been inflicted among us as among them. Efficient bayonet work behind the barricade was all that was relied on.

A native attack is always sudden and unexpected and begins with the throwing of spears and then closing in with dows. When attacking a marching column from ambush during the day,

ammunition was taken away from the soldiers and not returned until the next morning. The four whites did, however, retain theirs. Native troops, such as we had, were most efficient jungle folk and, being from a foreign area, enemies of the local population. It was not considered safe, however, to leave rifle ammunition in their hands over night. Should an attack have occurred in the dark and any indiscriminate firing have started on our

their commonest way is to choose a spot at the crest of a hill and wait for the advance guard. Natives, having climbed a long hill and reached the top, have a tendency to halt for a moment to get their breath. At such a time their watchfulness is generally momentarily relaxed. From past experience, this was well known and orders were given that, when hill crests were reached, there was to be no stop and precautions were to



THE DINING ROOM IN THE FORTIFIED CAMP

A native attack is always sudden, beginning with the throwing of spears, and even when members of the punitive expedition were dining, they had to be on the alert

PROTECTION AGAINST NIGHT ATTACKS

The sharpened bamboo defenses and a sentry box, preparedness against invaders, are shown here

be redoubled. It may readily be understood that advance guards are not popular details so, to be fair, a change in personnel was made in these each day. There is no possible way to apprehend ambushes, as the jungle alongside the trail is so dense that flank guards cannot be sent out.

This little punitive expedition proved most successful. All our objectives were accomplished and fortunately no fighting occurred. Amelioration of penalties was always attempted and in some cases fraternization sprang up. Visitors in small numbers were allowed into camp and in one case a headman sent his sons, all dressed in gala costume, to visit us. When this trip was over, we returned to the main station at Kohima. No over-emphasis can be given to the efficiency of the District Commissioner during my



relationship with him in both our tours of the administered and unadministered areas. He had spent years among the natives as a civil officer and, in the former area, had most excellently administered His Majesty's justice. His tour comprised areas inhabited by the Angami, Ao, Sema, and Koniak Nagas, and, as an anthropological scholar, his knowledge of them was unsurpassed.



INTERVIEWING HEAD MEN IN A KONIAK VILLAGE

On the punitive expedition sent out by the British government, following head-hunting raids in the valley, the head men of the villages were visited and warned against further infraction of the law



Showing the Phantom Ship, Wizard Island, and Portions of the Rim of Crater Lake

CRATER LAKE—AN EPIC IN VOLCANOLOGY

A Page from the Vast Book of the Geologic Past

By ERNEST A. ROSTEL

CRATER Lake National Park in southern Oregon is a rich repository of Nature's handiwork reverting to ancient days when volcanism was an all-ruling force in northwestern United States.

Resting in the caldera of an extinct volcano in the high Cascade Mountains, Crater Lake is 2000 feet deep, 6 miles across, and has a circular shore line of 26 miles, surrounded by beetling lava cliffs and crater walls ranging in height from 550 to nearly 2000 feet. To preserve this wonder spot for the sole enjoyment of the people, the 249 square miles comprising the area were set aside in 1902 as a national park.

The calm waters of unbelievable blue, surrounded by multi-colored, precipitous walls, at once deeply impress every visitor. Despite persistent research over a long period of years, revealing considerable of the geologic past of Crater Lake, there is much yet to be learned. The conclusive interpretation of its origin can truly be regarded as a challenge to the scientific world.

Evidences of volcanism are apparent throughout the Cascade range, one of the outstanding mountain chains on the North

American continent, extending, as it does, across both Oregon and Washington. Sedimentary rocks, the results of water deposits, are practically unknown in these mountains, a fact that indicates great volcanic activity thousands of years ago during and after the formation of the range.

The Cascades in what now is southern Oregon were no exception to this far-flung reach of volcanism. There took place in this region the development of a volcano, comparable in size to if not larger than, the mighty fire mountains of the northwest, Mt. Rainier (14,408 feet) in Washington and Mt. Shasta (14,161 feet) in California, landmarks of this region where geologic history was made.

It is believed that, as a result of volcanic activity covering countless centuries, the southern Oregon volcano reared its lofty summit into the heavens for 15,000 feet. Though it has disappeared, the mountain that was has been named Mt. Mazama. Examination of the cliffs surrounding the lake has resulted in the discovery of many layers of lava and fragmental material, true evidence of the long development and upbuilding of the giant

mountain. While these layers appear horizontal when viewed from the rim, investigation shows that they slope gently away from the lake and are not uniform in thickness or formation.

Geologists point out that while one layer may be of lava from five to ten feet in thickness, the next may be composed of pumice or volcanic breccia thirty feet or more in thickness, each accumulation indicative of an eruption covering an indefinite length of time. At one point of the crater wall thirty layers are visible.

For ages these eruptions continued, slowly building up the mountain, but, of course, they were not continuous. Periods of inactivity brought rest to seething fires, encouraging the growth of vegetation, trees, and flowers, on lower levels, and the formation of deep snow and ice on higher elevations. As years passed, glaciers formed, and as centuries went by, they slowly moved. They were never seen by the eyes of man, but the routes they took in moving down the slopes of old Mazama were marked by the great

glacial valleys which they carved, and which today can be seen along different points of the rim. Traces of these once present glaciers are indelibly impressed on the rocks over which they irresistibly made their way.

Pages of dim yesterdays indicate the presence of a glacier that must have been four miles wide and hundreds of feet deep at its front, grinding down from the heights of Mazama to the headwaters of the Rogue River.

Geologists who have made investigations of the inner slopes of the rim, found interesting glacial formations. At Discovery Point on the west rim, from which John Wesley Hillman, a miner, discovered Crater Lake in 1853, a layer of material has been found containing smooth polished boulders intermingled with finer debris. This accumulation rests upon a striated lava surface. Farther down a similar layer is present.

Evidence, such as this, it is said, shows periods of glaciation between different eruptions. The reign of the glaciers may



Photo by Kiser

DUTTON CLIFF

Stolid and majestic, it rises from the silent blue, while at anchor rests a mystic craft on a sapphire sea

ing messages from unknown and forgotten years.

A mountain, with whose summit the clouds played tag, is gone, but in its destruction mute records were left behind. For some geologists these records tell a story which explains the disappearance of the giant peak. Though this evidence is acceptable to many other geologists, some have different theories. That of collapse has been expounded many times. Explosive destruction has been suggested. And there are geologists who doubt the possibility of a mountain existing as high as is set forth in the first two mentioned theories, and who say that the volcanic activity of Crater Lake was similar to that now in progress in Hawaii.

Be that as it may, in speaking of the first theory, of such huge proportions was the destruction of the mountain that it is almost beyond the human imagination. With centuries upon centuries of eruptions following each other, it is suggested that the structure of the volcano was greatly weakened. It was no longer able to withstand the fury of its own vast

power. There was a terrific crash and another and another, as the majestic mountain collapsed within itself. Not all at once, of course, but during the passage of the years it was gradually destroyed. Large areas fell into an immense volcanic pit where deep down lay a glowing lava lake of blinding brightness and somber dullness, sending forth gases and vapors of extreme heat. Into this inferno fell portions of the collapsing mountain and disappeared in its fiery depths.

How long this process continued can never be known except that it no doubt covered many years, during which destruction progressed slowly, ultimately eliminating forever the majestic splendor of the monarch of the Cascade range. In its dying throes, it may have superseded any similar activity in the world. The caldera of the volcano, much like the old shell of the mountain, is large in comparison with Katmai in Alaska, where the attention of the world was focused in 1912 when its summit was destroyed, leaving a caldera having a circumference of 7.6 miles as compared to Crater Lake's



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A GLIMPSE OF THE SHORE LINE

The east rim of Crater Lake and Mt. Scott in the soft hush of a peaceful autumn day



Photo by Kiser

GARFIELD PEAK

A lonely sentinel on the shores of the sea of silence

26 miles by shore line and 35 miles by road.

Whither the melted material of the old mountain went after falling into the fire pit, no person is certain. It may have been drained off in underground passages, but no direct evidence has been unearthed to support this theory.

Though the giant volcano was dying with its collapse, it was far from through. Perhaps in an effort to rebuild itself, three cinder cones were thrown up from the crater floor as time went by. These three cones erupted in their own right as individual volcanoes and built themselves hundreds of feet above their base. It is said they erupted for centuries.

As changing seasons came and went, growing into years, gradually their fires died. Peace came to reign where volcanism had held sway. The cones were dead as far as volcanism was concerned. Lava, once boiling, became cold. Desola-

tion settled over the region in the midst of an all-pervading silence. The roar of its volcanic efforts was stilled. The sky was free of smoke.

A caldera 4000 feet deep, with three cinder cones on its floor, marked the tomb of what was perhaps the greatest example of volcanism on the continent. The crater walls, composed of layers of lava, thrust themselves above the vast pit which they surround. Cross sections of glacial valleys were easy to discern, but more interesting were cross sections of lava-filled glacial valleys, appearing as if some giant knife had cut lava flows into two parts.

At an elevation averaging 7000 feet in the rim area, with some points over 8000, winter storms descended in terrific fury. Snows piled deep and in the spring melted with the warming rays of the sun of a milder season. Pools of water formed on the caldera floor. With the return and



Photo by Kiser

A NATURAL FRAMEWORK

Formed by a tunnel of lava along the west rim of the lake



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FROM THE SUMMIT OF THE "WATCHMAN"

Hillman Peak is in the foreground, and to the left are Lao Rock and portions of the rim. Mt. Thielsen looms in the distant background, while the Rim Road shows plainly in the foreground

departure of frigid weather in the next season, the pools became deeper, retaining snow water which had failed to evaporate. Year after year this process continued until a lake was born. It continued to grow deeper, creeping up the sides of the cinder cones—up the sides of the crater walls. Water reached the summit of one cone and submerged it. As decades passed, the water reached the summit of the second and covered that, but yet the lake had not reached its ultimate depth.

Gradually the water level crept higher up the sides of the third cone. No doubt it reached porous sections of the crater walls, through which the water seeped away, to appear possibly as springs on lower levels, and the lake grew no deeper. The third cone was entirely surrounded and today greets park visitors as Wizard Island. The island covers an area of 563 acres and is composed of lava, cinders, and ashes, while its summit is 763 feet above the water. Its crater is nearly one hundred feet in depth and four hundred in

diameter. Despite its rocky composition, forests of hemlock found root in the lava, and now clothe the slopes with perpetual green. In their season wild flowers bloom in profusion, at certain points resembling living bouquets of color.

The National Park Service has constructed a wide, comfortable trail to the summit of the island and into its crater. During the course of the travel season, regular guided field trips are made up the cone, providing visitors with first-hand knowledge of its volcanic activity.

While Wizard Island is located on the western side of the lake, a strange lava formation juts out of the water on the opposite side to a height of 162 feet, and a length of 200 feet. Deriving its name from the fact that it seems to disappear in certain lights by blending with the crater walls and because of its general resemblance to a ship under full sail, the formation has long been known as "The Phantom Ship." Resting close to the base of Dutton Cliff, the second highest point of the rim, 1973 feet above the water or six

feet lower than Hillman Peak, the Phantom Ship does much to enhance the mystic beauty of the lake.

The origin of Crater Lake through the collapse theory is implicitly believed by many to be the background for the wondrous beauty of this scenic gem of the Cascades. The theory of explosion is explained by others as a part of the history of Crater Lake, and they cite the destruction of Mt. Katmai in Alaska in 1912, when explosions were heard nearly eight hundred miles away. Volcanic ashes fell on ships hundreds of miles at sea while gases in acid rains damaged clothes hundreds of miles to the south.

The destruction of Mazama is compared to Katmai in the disappearance of its summit. The possibility is also voiced that the former underwent explosion and collapse in the same operation. Vast acres of pumice many feet deep, believed to have been thrown there by explosive action, surround certain portions of the lake, giving weight to the theory of explosion. This frothy rock, which is light enough to float on water, is also found at some distance from the lake.

To afford visitors as many opportunities as possible to appreciate fully the beauty of Crater Lake and to gain knowledge of the geologic history of the region, the National Park Service has gone to considerable lengths. Notable among these efforts is the Sinnott Me-

morial, an observation station and museum, located on the west rim, not far from a lodge, open during the summer months.

The construction of the building was authorized by the United States Congress as a memorial to the late Nicholas Sin-

nott, former Oregon congressman, who was active in congressional affairs for many years. Built of native stone, the building blends perfectly with the surrounding landscape, and is located a short distance within the inner rim. The observation station serves as an ideal orientation point, providing a complete panorama of the lake area, with its twenty square miles. A museum is also being established in conjunction with it.



THE PHANTOM SHIP
A stately argosy of stone

Through aid tendered by the Carnegie Institution of Washington, D.C., a series of high-powered binoculars have been installed on the memorial parapet together with display cases containing different exhibits of volcanic material. Trained on rim points which are important because of their relationship to geologic history, the glasses enable the visitor to understand readily what transpired in prehistoric times, setting forth how the mountain was built and destroyed, revealing action of glaciers, and providing an opportunity for the leisurely inspection of the lava flows. Specimens of lava and other material on which the binoculars are pointed are displayed in cases alongside.

The installation of this parapet equip-

ment was planned by Dr. John C. Merriam, president of the Carnegie Institution, in an effort to bring out the greatest possible appreciation of lake beauty and geologic history. He received coöperation in carrying out these plans from Ansel F. Hall, senior naturalist of the National Park Service, E. C. Solinsky, superintendent, and D. S. Libbey, naturalist, for Crater Lake national park. The popularity of the orientation point was proved last summer when thousands of persons visited it, and gained information not only by views through the glasses but also through the medium of hourly lectures given by members of the educational division staff.

The educational division, under Mr. Libbey's direction, provides numerous services such as conducted walking trips to points of interest and guided motor drives around the rim for a distance of thirty-five miles, including stops at designated observation points, where short lectures are given, explaining different examples of geologic phenomena. The construction of a new rim road, wide and hard-surfaced, is under way to add to the lure of the drive, the only one of its kind in the world.

Guided boat trips along the base of the towering cliffs are among the outstanding attractions of the summer travel season. These trips afford visitors the opportunity of closely scrutinizing the forma-

tion of the crater walls. Nightly programs, consisting of light entertainment and lectures, presented by the educational division on lake topics, are carried on during the travel season, when visitors arrive from every state in the union and from distant foreign countries. For the past season, closing October 1, the number of these exceeded 110,000.

Though the majestic splendor of Crater Lake is the outstanding attraction of the park, there are numerous side trips of extraordinary interest.

Among these are the pinnacles of Sand Creek, a short distance east of the lake—an uncanny group of spectral spires in a glacial valley formed years ago and then filled with a flow of volcanic material. The result of erosion carried on slowly

through the years, the spires are of volcanic ash and fragmental material which have withstood the action of erosion while the softer material about them was worn away. Some of the pinnacles are 200 feet in height. Their only known rivals are located in South America and are said to be far less perfect than those of Crater Lake. Other examples of erosion are to be found in Godfrey Glenn along the south entrance road.



© Patterson

THE "PINNACLES"

An uncanny crowd of spectral figures

During the summer the park is a veritable living bouquet of flowers, of which 377 varieties have been classified within the boundaries, including a number not common to other regions.

Park forests are representative of high altitude areas, their growth governed by different life zones, corresponding to the altitude of each zone, with the highest known as the Hudsonian in the rim area, ranging in elevation from 6250 to 9000 feet. The climate here is similar to that of the Hudson Bay region, with the white bark pine best suited to withstand the climatic rigors of the zone. Below this down to 5500 feet is the Canadian zone and under that the transition zone, where life forms of the upper two zones mingle with that of the Sonoran zone, the only one here mentioned not represented within the park. Mountain hemlock is the most prevalent tree found within the park.

Park visitors, in addition to taking advantage of many scenic attractions, are always interested in wild life. In this division are found bears, deer, elk, marmots, porcupines, chipmunks, and numerous other forms of animal life. Birds, like animals are mostly migratory, leaving with the arrival of winter when snows cover the ground to a depth of twenty feet, but they are well represented during

the summer. More than eighty varieties have been classified.

A visitor is wise to pause for an entire day, or better yet for several days, to gain complete appreciation of the beauties of Crater Lake by climbing mountain peaks, taking lake excursions, taking advantage of numerous side trips, availing himself of services offered by the educational division, trying his angler's luck in fishing for trout with which the lake abounds, and making himself comfortable in free camp grounds maintained by the park service or at an up-to-date lodge.

But above all, the visitor will never forget the beauty of the sublime scene, or the mystic silence of the bluest of blue waters in the world, the color popularly attributed to depth and the powers of light refraction. After having once been there, the visitor will return again and again to the region where Nature so extravagantly lavished her scenic treasures. The scientist and especially the geologist will always regard Crater Lake as a storehouse of geologic knowledge, never failing as a great text book containing many of the secrets of time.



CRATER LAKE UNDER A COVERING OF OCTOBER SNOWS



THE MOUNTAIN PLOVERS OF THE PRAIRIES

Photographing the Little Brown Plovers That Nest on the Prairies Bordering
the Foothills of the Rockies

By ALFRED M. BAILEY AND ROBERT J. NIEDRACH

PHOTOGRAPHS BY THE AUTHORS

THE wind-swept prairies bordering the foothills of the Rockies appear bleak and cold during the early days of spring, but, as the season rolls along and the sun mounts higher in the sky, many changes occur. The prairies become vistas of green dotted with nodding heads of wild flowers of many hues, and the calls of birds may be heard from far and near. There are several species of birds which one may always find on these plateaus, some nesting upon the ground and others in the willows and cottonwoods which line the stream beds of the rugged arroyos, but, of them all, we like the drab-colored mountain plover. This little, brownish fellow with the light-colored breast seems misnamed, for it is a bird of the short grass plains—not of the mountainous region, and while it is a “shore bird,” it is rarely seen near water. But the mountains are not far away, for the foothills loom blue in the distance,

while beyond are the snow-capped crests of Colorado's innumerable peaks which form the Continental Divide.

The mountain plover is a species unknown to most naturalists, for its range is restricted, and while comparatively few are acquainted with the living bird, fewer still have pried into its family affairs. Owing to its secretive habits and the protective coloration of its eggs, the nests are exceedingly hard to find. We have been acquainted with these fellows for many years, for we have been neighbors, and yet, while we have found nests and have been on speaking terms with many individuals, our knowledge of their habits has been extremely limited.

Memories take us back years ago to our first days in the haunts of the mountain plovers. We were not familiar with their ways and did not know where to look for nests, so we were having our troubles. Several of our party combed the prairies



AVERSE TO PUBLICITY

Some of the plovers resented the familiarities of the photographer and refused to settle on the nest as long as the blind was near

where birds were seen, but the eggs were not found.

Strategy was finally resorted to, and two of the group lay upon the grass and watched a pair of birds, hoping one might return to its nest. The plovers appeared solicitous and circled anxiously, giving occasional soft calls. They would not leave the vicinity, and their distress was so apparent that the boys decided that possibly they were too close to the nest. They crawled some distance away and had barely established themselves in a new vantage place before one of the birds approached to within a few feet of where the young men had been crouching. It bobbed up and down for several moments, with jerking movements characteristic of the species; and then settled, an investigation showed that one of the young naturalists had been lying within arm's length of the nest for an hour.

This past season we were visiting our

plover country in the hope that we could find a pair which would not mind having its home affairs recorded on motion film, for we were making life-history studies for the Chicago Academy of Sciences and the Colorado Museum of Natural History. We searched the level short-grass prairies east of Denver, early in May, and found our little brown friends of other years upon their favorite breeding grounds. The melodious calls of the males could be heard from different localities, showing that several pairs were in the near vicinity; occasionally one would rise into the sky, poise at a height with fast beating wings as it uttered its clear spring song, and then, as the call died away, float back to earth.

We walked across the cactus-studded expanse and found five different pairs, apparently settled for the season, and after a while we decided that two, at least, would soon be nesting.

Many trips were made in the days that followed—eggs were found and our photographic blinds were erected. The plovers were like humans,—some resented our familiarities and refused to return to their nests as long as our blind was near; another pair objected to our presence, but the nesting instinct was strong enough to overcome natural timidity, while still another pair paid no attention to us, once we were concealed within the canvas shelter.

The three dark eggs in each case were deposited in a scantily lined cuplike depression on the prairie, and as grazing stock was always near, the nests were in constant danger. Many must be destroyed; in fact, from the seven nests which we had under observation, only three sets of young were hatched.

We soon found, after a little experimenting, which plovers would tolerate us; our blind was erected within six feet of

the nest, the motion camera was trained upon the eggs, and we awaited the return of the parent bird. It was not a long wait, a half hour or so, during which time the brown fellow circled the hiding place continuously. Finally, satisfied that all was well, she headed directly for the nest, and while the camera buzzed, paused momentarily astride the eggs to study us with her large, dark eyes, and then settled down.

We lived with this pair of birds during the days that followed; we visited them on dark, stormy days, when the wind whined across the low country and whipped the canvas of our blind so that it seemed as if it must be torn to shreds; we crouched in our shelter on hot days when the plover was panting upon her nest, and on others when chill winds and driving rains made her crouch as close to the ground as possible. It was just before hatching time that we had our



NOT IN THE BEST OF HUMOR

The bird would run forward with wings outstretched and beak snapping in an effort to intimidate the creature making the disturbance



THE NEST OF THE MOUNTAIN PLOVER

The three dark eggs were
deposited in a scantily
lined cuplike depression
on the prairie



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WHILE THE CAMERA BUZZED

The little plover carried
on its parental duties
despite the blanket of
snow that had been
deposited by a driving
snowstorm

EYEING THE
PHOTOGRAPHER'S
BLIND

Sometimes the bird
would return quickly to
the nest and pay no
attention to the noise of
the camera, and at other
times it would run some
distance away and call
plaintively

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X



CAMOUFLAGE

At the first warning sig-
nal from the old birds,
the chicks would drop in
the shadow of some plant
and remain motionless



real treat, for a driving snowstorm swept across the prairies, and we watched from our "peek-hole" as the little plover carried on. "Our plovers," as we called them, did not always act the same. Sometimes a bird would quickly return to the nest and would pay no attention to the noise of the camera; if we should show a hand through an opening in the canvas, it would often run some distance away and call plaintively,—or, if not feeling in the best of humor, it would run forward with wings outstretched and beak snapping, in an effort to intimidate the creature making the disturbance.

Cloud-flecked skies and smiling days greeted the plovers when their tan-colored chicks were ushered into the world. The babies were long-legged little creatures which were able to leave the nest as soon as their down was dry, so our blind was of little use to us. We often

watched an adult walking over the flower-splotched prairies, closely followed by fuzzy youngsters which were still a little wobbly upon their ungainly legs, and we occasionally drove our car within a short distance of them before the old one would give a warning signal. Then the babies would drop in the shadows of some plant and lie motionless for minutes at a time. We attempted to secure motion films of the adult with the young, but our efforts always ended in failure, for although we set up our blinds near the little ones, hoping the parents would approach, the wise old plovers defeated us by calling their babies away. So, after several weeks of sunshine and storm upon the level prairies, which extend eastward from the blue foothills, we had to be content with what we had, and hope that sometime in the future we could finish our pictures of the little brown plovers of the prairies.



THE TAN-COLORED LITTLE CHICKS WERE ABLE TO LEAVE THE NEST
AS SOON AS THEIR DOWN WAS DRY



Pack and Saddle Animals at Sorata Awaiting Loads and Riders

MOUNTAIN BY-WAYS OF BOLIVIA

An Account of an Expedition to the Cordillera Real—
the Eastern Slope of the Andes

BY G. H. H. TATE

Assistant Curator of South American Mammals, American Museum

PHOTOGRAPHS BY H. S. LADEW

Mr. Tate accompanied Mr. Harvey S. Ladew, who generously defrayed the greater part of the expenses of the expedition to Bolivia during the first half of 1926. The objectives of the expedition were to afford Mr. Ladew a general view of the countries of southern South America and to bring back collections of mammals, birds, and plants from the eastern slopes of the Cordillera Real, Bolivia. The general efficiency of such small expeditions is illustrated by the fact that in only four months spent in the field more than 600 mammals, several hundred birds, and more than 1000 sheets of plants were obtained.—THE EDITORS.

IT has been said that field trips for the purpose of collecting specimens and data constitute one of the more important functions of the modern museum. Few people realize, however, that, for every really big expedition, sent into the field, replete with automobiles and numerous personnel, a score of lesser parties are dispatched comprising from two to four people and their impedimenta. These lesser projects, with their proportionately low cost, compactness, and mobility, are in all truth, the sources from which the American Museum secures the greater part of its rapidly growing collections. Large undertakings, operating over long periods of time, although capable of

achieving results quite unattainable by small parties, which rarely spend more than a year in the field, necessarily entail very high fixed expenses. These militate strongly against the cost-efficiency of larger expeditions, especially if for any reason their work be hampered or interrupted.

A few years ago plans for one of these snug little trips were laid in the American Museum offices, the objective being the eastern slope of the Bolivian Andes. By the most direct of air routes La Paz is little more than two hundred miles from the Pacific Ocean, but the railroad that climbs from the port of Arica up among the Andes to this capital city of Bolivia wanders and winds across many



A VILLAGE ON THE MAPIRI RIVER

Little towns such as this form the transfer points between the mule roads of the Sierra and the highest points of navigation by canoe and raft of the Amazonian river system

an extra mile. Furthermore, with an accurate map and a pair of calipers you can readily learn that only forty miles or so separate La Paz from Lake Titicaca, and that the town of Sorata is not more than seventy miles away. But few maps will give any accurate idea of the condition and the meanderings of Bolivian roads. Thus it is not by mileage alone that our movements should be judged, when, after having been separated for a month, Mr. Ladew, his valet, Sherin, and I, with some native assistants, set off in a heavily laden car, and with one of the men clinging to the running board, bounced, swayed, and splashed over bumps and through puddles on our trip from La Paz northwest to Sorata.

We crossed miles of nearly flat plateau, formed of morainal aprons from the snow-clad mountains, and, at risk occasionally of broken springs or sprung axles, came at length, without special incident, in sight

of Lake Titicaca. High in the Andes, this great body of water was a beautiful sight. One nearly land-locked bay as smooth as blue glass was broken by several islands and headlands, the nearer ones almost brick red and outlined against the deep purplish blue of those more distant. In the shallows a pretty yellow water weed floated upon the surface, and just beyond it a thin screen of dark green rushes grew, the two combining to form most pleasing color contrasts. Here and there picturesque reed boats or "balsas" floated. One of them, poled by an Indian, lay so low in the water that the man appeared to stand on a deep-floating log or on the back of some forbearing alligator rather than in a boat. On the shore of the bay several picturesquely dressed Indian women tended a flock of sheep, and a little distance off, on the stony hillside, a man urged a team of sleepy oxen to drag one of the heavy wooden

plows still everywhere used in this region.

When we lunched by the roadside, our Indian of the balsa came to have a closer look at us. Ladew, after carefully setting his camera, edged stealthily around to the man's sunny side to try for a picture of him without frightening him away, while I, with my best Spanish, tried to hold his attention. We need not have troubled, however, for as soon as the Indian saw what was afoot, he smiled, posed with arms partly folded, and calmly waited the release of the shutter.

We passed the village of Marina and crossed some rolling hills to the larger town of Achacachi. Decoration of native towns of the Andes seemed to run by fashions. The favorite mode for the Achacachi houses was a kind of salmon shade with the doors dark blue. It was here that one of the men told me "This is a terrible place—they shoot many shots." However, they did not shoot at us, so it made no difference.

Crossing a large, bird-haunted marsh, we followed a winding way by easy grades up a high ridge to the northward. Along the road were many Indian houses near which every available spot had been carefully cleared of the multitude of ice-rounded stones and had been planted with ocas and potatoes; but eventually we got beyond all dwellings and came out upon smoothly rounded hill-tops carpeted with short, crisp grasses and the tiny flowers of the "puno bravo," which, as Sherin remarked, would make a capital golf course. At the very summit of this ridge, more than 15,000 feet above sea level, we saw a large pile of stones about ten feet high which, we were told, represented offerings from superstitious Indians to the evil spirits who live on high passes. We, however, with civilized disregard for the demons of the place, left no offerings ourselves.

On the lip of the really magnificent Sorata Canyon we paused to enjoy the view. One minute one rides over smooth,



LOADING A REFRACTORY BEAST

No time is wasted on nervous or irritable pack animals. They are quickly and neatly blindfolded by tying a blanket or poncho around their heads, after which the cargoes can be adjusted at leisure



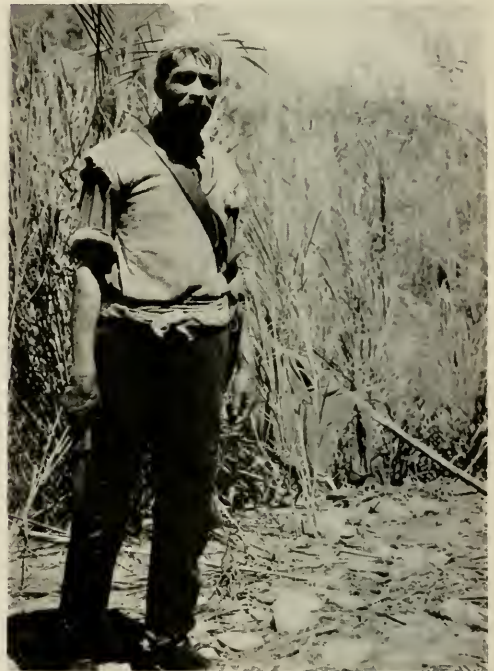
BY THE MAPIRI RIVER

Snakes were not frequently encountered. The one which Mr. Tate is holding had been killed and brought to camp skewered through the head with a sliver of bamboo

nearly level grasslands, the next, one gazes down into unbelievable depths. This huge gash is a wonderful example of the erosive power of water. Not a flat spot can be seen down the sides of the cañon, and the few villages that meet one's eye seem to cling like mud wasps' nests to the mountain-side. Over a wonderfully good road we zig-zagged down into the valley for two hours to the town of Sorata, which we reached at 5:30 that afternoon. We found rooms at a clean little hostelry near the house of the gentleman to whom we had letters of introduction, and after cleaning up, we called on him and explained our plans. Whereupon he went out and battled royally with the brigands of mule drivers on our behalf, and, coming out victorious, announced that we might start in the morning on the next leg of our trip, where a car could not be used.

Delighted at the prospect of so quick a departure, we turned in. But when morning came the "arrieros" with their mules were, of course, late, and even when they did arrive, there was the usual fuss and flurry of loading. Fortunately, however, they had decided the evening before who was to carry which load, and many of them had corded up their packages in advance. Thus, ultimately, we started, and seeing scarcely one flat spot, slowly climbed the side of the north-westerly spur of snow-covered Mt. Illampu to more than 14,000 feet. The perfect day afforded us a splendid view of the snow-clad mass. I could even distinguish the seracs of three of the ten glaciers which faced us.

Sheltered from the wind, we ate lunch in the bright sunshine at a spot called Chuchu, the altitude of which was 16,400 feet. Breathing had become rather



THE "PIRATE"

In spite of his cropped ear and his picturesque attire which earned for him the above sobriquet, Bozo was by far the best and most cheerful of the men who worked for the expedition



WEIGHING BAGGAGE AT MAPIRI

It is interesting to speculate as to the fate of the carefully written document showing the weights of each box and bag of the expedition's equipment which the gentleman at the left of the picture insisted on obtaining

difficult and we did not attempt to move about very much. However, I succeeded in catching specimens of some butterflies and other insects which seemed too wearied by the strong wind to put forth much effort to escape. They were, in fact, constantly buffeted about until they could grasp some tufted vegetation and cling there.

After four days on the trail, during which we moved slowly, collecting as we went, and while still a day from the village of Mapiri, we came upon a country where butterflies were very abundant, and we hit upon the idea of collecting them from mule-back. My mule, which had a rather sensitive disposition, (sensitive, at least, for a mule) showed some apprehension the first time the big net swung upward from the ground just in front of her nose, and even entertained the idea for a moment that she had business elsewhere, but she soon became used to it and ultimately rarely did more than wag her ears as the net swept under

her neck from time to time. We found this a very good way to collect the big blue *Morphos*, whose custom it is to float lazily along the trails ten or twelve feet from the ground. To catch a *Morpho* butterfly looks the easiest thing in the world, but when you try it, you find yourself emulating the performances of Olympic athletes as you vainly struggle to reach the exasperating insects.

On the afternoon of the fourth day we dropped down into the tropics proper. After passing the usual banana and yucca patches, half overgrown by encroaching wild vegetation, we crossed a tiny stream amid a swirl of disturbed butterflies and thirsty mules, and half an hour later came out on a flat overlooking Mapiri. We were expected, and a palm-thatched house had been cleared for our accommodation, but, rather disappointing the owners of the house, we went straight to the river bank. Making camp was the usual circus proceeding: a frenzied rush to get the tents up, a hundred jobs to do all at the



READY TO PUSH OFF

One of the *callapas* (rafts) loaded with miscellaneous baggage, which were used in floating down the Mapiri River

same time, but eventually everything became orderly, and after an excellent meal prepared by Sherin, we felt quite revived. Ladew and I papered our capture of butterflies by the conjoined light of the moon and an electric torch, and later Sherin and I strolled for a short time along the broad, gravelly shore of the river. Big frogs kept up a deep barking by the water-side during the night and once I got up to drive a cow out of camp. In the morning we moved a mile or two up-stream and pitched our tents in the forest at the water's edge.

Mr. Ladew developed a tremendous lust for butterflies, especially the large *Morphos*, and pursued them relentlessly even during the hottest hours. Behind us in a little glen, through which our water supply flowed (a tiny stream tumbling over a tiny fall), he had his headquarters and spent a good deal of his time in a camp chair reading, with his trusty net and killing jar always ready. Sherin pottered about, arranging equipment, planning meals, and incidentally

doing most of the cooking. He also took an occasional turn at catching the elusive *mariposas*. We took a dip in the river at least once a day. It was delightful just before lunch to strip and swim for a few minutes in the quite cold water of the Mapiri.

Often as we lunched, it amused us to watch the activities of the leaf-cutting ants. I have never seen these insects so abundant as they were in the Mapiri-Tipuani region. They by no means confined their attention to leaves, but cut up and carried away the paper labels of cracker cans, leather boot laces, banana peel, and almost everything they came across. They attacked even the "balloon silk" of which the tent was made, and one night they found Sherin's oiled silk tobacco pouch in one of the side pockets of his coat, which hung from a branch, and removed about three-quarters of it. During our walks we frequently came across their great excavations in the soil thrown out from the many entrances of their complex nests. Such nests, which

covered many square yards of ground, reminded one of volcanic territory on a tiny scale—some parts seemed dormant and unused, and in others violent activity reigned, with swarms of ants carrying out freshly dug bits of soil which they deposited around that particular entrance in the form of a cone. From other entrances, which seemed to be completed, a steady stream of tireless insects passed and repassed, those leaving the nest carrying nothing, those returning as a rule hurrying back with a piece of leaf or bit of paper or a twig, larger than themselves. Their highways were six inches broad, scrupulously cleared of every twig and blade of grass, and might reach lengths of hundreds of yards. Often they availed themselves of foot paths and natural objects like fallen trees. In Ecuador, I once saw a railroad track that made a splendid path for them which they frequently used.

Before leaving Sorata we had engaged three men to work as collectors and skin-

ners. Needless to say, they had all represented themselves as experts at their respective jobs. The stupidest one came in one day to say that a snake had almost bitten him and that he was afraid to venture into the bush any more, so we sent him home the next morning. Another named Vernal, a man of melancholy disposition, who was disposed to think himself far too high-born to be compelled to work for a living, was setting traps with me one afternoon. It was about five o'clock when I heard several large toucans calling in the tree tops, so I sent Vernal down to camp for some No. 6 shells, and then we started to stalk them. A bird was hit hard and volplaned down into a canebrake. I hurried into the brake to secure the specimen and, having found it, went on down the trail to camp where, finding that supper had been ready for some time, I sat down at once. Presently, someone discovered that Vernal had not returned. It was almost dark, so I put on a headlight and hurried back to where



FLOATING DOWN A TRANQUIL REACH

The man wearing leather puttees had shortly before lost his way in the woods

I had left him, but could see no sign of him. Although I went up and down trails calling and firing off my gun, I could hear nothing, and soon I had to go back to camp to change the batteries of my light. I then gave a hand torch to Bozo, our third man, who was a good woodsman, and he and I searched all trails for a long way around. We got back about the same time, some two and a half hours later, without either one of us having found any trace of Vernal. Meanwhile Ladew and Sherin had kindled a large fire on the beach. We were quite worried, fearing that he might have lost his head and run into the woods where, perhaps, he had fallen over a cliff and injured himself. In the morning he walked calmly into camp and accused me of leaving him alone to perish in the jungle (five minutes walk from camp). It seemed that he had quite lost his head the night before and wandered about until he had emerged

from the forest near a little hacienda about half a mile distant.

Our third man, who was officially named Bozo, we nicknamed the "Pirate" on account of his physical appearance. He wore a very dirty handkerchief tied tightly around his head, had long moustaches and only one effective eye, which was brown. The other eye, which continually seemed to try to see the ear of the same side, was bluish. He possessed by far the most energetic and interesting personality of the three. He came to me one day, and asked for the afternoon off to go over to the church in Mapiri and pray. Both he and I had a good idea of why he wanted to go to the village, so I told him that I had no objection to his praying, but he must do it in camp. He thought this was an excellent joke and roared with laughter. As I have stated, he was a good woodsman and could find his way anywhere in the forest.



THE "HARDSHIPS" OF MODERN EXPLORATION

Mr. Tate's own raft was very comfortably arrayed with awnings and camp chairs *ad lib.* Unfortunately no picture could be taken to demonstrate the not infrequent partial submergence of the craft



TYING UP FOR THE NIGHT

This photograph, taken at the mouth of the Chimate River, shows the gravel bar which a subsequent rise of the water obliged the expedition's men to vacate

To all three of these men we paid regular wages, but I soon found that they required more incentive than this to attend properly to their work. Earlier during the same afternoon when Vernal had his adventure, I heard the sound of chopping and then a tapping sound, which proved to be caused by our Pirate, thus caught red-handed as he was tapping rubber trees instead of attending to his work. He had just driven one little tin collecting cup into the bark and was in the act of placing another. After this, I changed our methods of payment, cutting their salaries in half and giving them a small bonus per specimen brought in. This brought about amazing results, and Bozo in particular worked very hard.

We arranged to go from Mapiri on rafts down the river to the little town of Guanay where mules from the mountains were to come by another road and carry us back to Sorata. The river men arrived

in due course and tied their balsa rafts together in threes to form *callapas*. By noon we had all our cargo stowed on two callapas and floated down the swirling river to the beach at Mapiri, where for no apparent reason everything had to be taken off again and weighed. The ancient and rusty scale had already been brought to the beach when we arrived, but of course the official who had to do the weighing was not there and was located only with difficulty.

Before we started again, our camp chairs were set up beneath rude shelters built on the rafts. The water continually rushed over the balsa rafts as we drifted downstream, so we took our shoes off and just let things swirl. After two and one-half hours of this sort of travel we pulled in at the mouth of a small river and camped for the night. I spied a group of about twenty butterflies sucking up moisture from the wet sand and pointed



MAIN STREET, GUANAY

The giant trees of the distant forest and the steep pitch and ample thatch of the house roofs suggest sufficiently the very heavy rainfall of the Mapiri region

them out to Ladew, who instantly stalked them and netted about a dozen. Fifteen minutes later the tents and cots were up and supper was being cooked.

The Mapiri flows in a winding course through a deep V-shaped gorge between high forest-clad mountains. In places these close in so that the stream is buffeted and thrust from one rock point to another, forming frequent very dangerous whirlpools that require all the *balseros'* skill to navigate successfully. Besides these, tremendous eddies and up-wellings develop along the face of the cliffs and in spots the river literally boils. Having nearly drowned myself in some rapids two days before, I still felt a little nervous as we crossed such places.

We spent about a week at the mouth of a small tributary—the Chimate. The topography was still hilly and the jungle very dense along the river sides, with much bamboo and thickets of the tall twenty-foot reeds used for poling rafts. After carving a place with much labor for our tents out of a clump of bamboos we finally had a very nice camp sufficiently

shaded to prevent undue heating of the tents at noon. The river men made themselves at home on a gravel bar, but a few hours afterward the Mapiri rose two feet and literally floated them off it, so they had to go several hundred yards up the tributary and make a new home.

It was Ladew's habit while we were camped here, to drag a camp chair down to the river bank in order to find a comfortable place to read, and on one occasion as he climbed the few steps up the steep bank back to the tent, chair in one hand and book in the other, his face came level with a snake which flickered out its tongue at him. The snake, it is true, moved off into the brush, but Vernal, the boy who had lost himself in the woods at Mapiri, solemnly assured Ladew that it was a "vibora" of a most deadly variety, because it had a pink tongue. Ladew, being unacquainted with the ways of South American snakes, was naturally suspicious of all of them and spent most of the rest of the afternoon secretly eyeing the vegetation about us and jerking the conversation from its normal course in order to ask

sundry questions about the ways of poisonous serpents. What kind of snake had appeared I never learned, for poisonous or not, it did not show itself again.

After breaking camp we floated for another half day down the rapids of Mapiri, finally reaching Guanay. A loud bang from the rear raft which we thought was caused by the men dynamiting fish, was in reality meant for a signal to the town's inhabitants that we were at hand. The whole population gathered at the river bank to receive us, headed by a tall old gentleman (of foreign extraction) with an up-turned moustache and pointed beard. He had, we learned, lived there for many years and was one of the fathers of the flock. We were more interested, however, in learning whether our mules had arrived. As luck would have it, a man came to our camp later that very day to report that several of the mules which were to take us back to Sorata had come and that the rest would arrive the next day.

Our camp, of course, became the center of things, much as when a circus reaches a town at home. Every person in the village found some excuse for passing by and taking a look at us. I went around the trap-line in the morning with the Pirate, who told me with great glee how people had said to him, when he was going to set traps, the afternoon before, "Where are you going?" and how he had answered, "Oh, I am just taking a message up to Tipuani," and all of this to deceive the good folk who might have secretly followed him into the woods and stolen his traps. As it was, he had made so many devious turns to throw them off the scent that he took nearly ten minutes himself to find each trap. We discovered them all at last, twenty of them, and two opossums and a mouse were the booty.

In the afternoon Vernal and I set out to hunt bats in the village police station. They had very considerably moved the prisoners the night before in order that the



GUANAY

Although no strains of music ever emanated from the conical-roofed building, the visiting party was credibly informed that it was the town bandstand. The house in the middle of the scene was the Guanay school



GOLD BEARING GRAVELS AT TIPUANI

When the expedition rode through the village at Tipuani, it was noted that two big hydraulic nozzles were cutting steadily into the river deposits and a squad of mountain Indians were shoveling the loosened materials into riffles. The manager of the mining work stated that they were recovering gold in paying quantities

bats might go in there unmolested. After half an hour's desperate effort with sticks in the dark little "calabozo," we had collected seven. Back in camp, I found that the rest of the mules had arrived from Sorata. Then the mail came by special messenger from Mapiri. All this excitement, coupled with seven unexpected bats to be skinned that evening, made a decided rush, but at length everything was done, and after speeding homeward several curious and belated visitors from the village, we went to bed.

In the morning we had the usual turmoil and bickering about cargoes, in which we were eventually beaten and had to hire a couple more mules. I found an opossum in a trap, but since the animal was immature, I let it go. I had put the harmless creature on a tree so that it might escape, but the sight-seers from the village immediately fell upon it and murdered it so that some day in the

future it or its progeny might not steal their chickens.

On the second day, the trail we had taken passed into a very narrow and dangerous part of the river gorge, being, in fact, cut into the face of a huge mountain mass which fronted immediately upon the water. It was here I met the Pirate riding back to notify me that a mule that had gone ahead with the drivers had bumped against a rock with its cargo and, rebounding, had fallen down the cliff into the river. It was easy to see that the animals should have been unloaded and the cargoes otherwise carried past this dangerous place. The fall was about thirty feet. One of the cases had broken loose and had sunk at the junction of the Tipuani and a lateral stream. The other, still tied to the mule, had been dragged ashore about 150 yards down-stream and on the other side. When I got there, the men had already crossed on a raft and

had brought both mule and the single case back to our side. The mule appeared quite indifferent to the whole incident. They had to open the box, which was badly smashed, to empty out the water. The case which we lost contained nearly all of Sherin's much-prized pots and pans, so that we had to do almost everything in the way of cooking thereafter on a frying pan.

During the next two days, as we climbed upward, the forest gradually dropped away behind us and we found ourselves at last winding up through grass-clad valleys with towering mountains on either hand. We arrived at the village of Ancoma, close to the base of Mt. Illampu, in mist and rain, but had our tents pitched and all ship-shape by five o'clock. The work was only just completed when the clouds cleared away and Illampu stood out in all its glory with one of its largest



VIEW OF THE MAPIRI RIVER

At this point the river is about two thousand feet above sea level



STREET SCENE IN LA PAZ

Indian girl (left) and Chola girl (right), the latter wearing the varnished straw hat characteristic of her class

glaciers fronting toward us. A little stream, some three meters wide, milky white in color from the melted snow, ran noisily around its meanders. From an eminence farther up the valley I could see clearly that it originated beneath the glacier. As the sun set behind the mountains to the west, youthful Indian shepherds and shepherdesses drove home their mixed herds of llamas and sheep. The heavy woolen ponchos of the natives, dyed bright blue or bright red, stood out strongly against the background of green. The llamas, queer as they were, somehow appeared graceful,—they looked at us so intently and so timidly, and they held their heads so high, their absurdly cupped ears so erect, and their odd tails so arched. If we waved our arms at them they sprang agilely from mound to mound up or down the hillside. After our four-thousand-foot climb, we were all tired, and retired

early by the light of the moon. Upon awaking next morning, we found the tents and tables coated with rime.

The way now led up a glaciated valley that gradually curved in the direction of Illampu. We rode very slowly so as not to tire our mules, passing many terminal moraines and wonderful scenery. On the other side of the highest point reached, 17,200 feet, the land seemed to drop away almost sheer into the Sorata valley. On our left stood Illampu, partly shrouded in clouds, its moraines and screes bright reddish brown. Beneath us huge grass-covered areas stretched out to the west. I began at once to gather the alpine flora which I saw about me and, with the exception of about two miles, collected along the whole way down to Sorata.

And now, once more, the "motor road" had been reached. Rough as it had seemed on our trip out, it seemed less bad now. For even the worst of automobiling is far more rapid and comfortable than tramping mountain trails on foot, or riding muleback.

La Paz, too, is a city, after all, and after the utter simplicity of the villages at which we had stayed and the mountain camps we had set up, here was comfort and ease which seemed, for a time, like luxury.

Our party broke up, Ladew and Sherin to go to Buenos Aires and thence to Europe, and I to climb the mountains again to add to our collections before returning by way of Lake Titicaca to the coast, there to take our varied collections back through the Panama Canal to the Museum in whose name we had gone out.



Camp at Ticunhuaya in an Opening in the Low Woods



A WASP QUEEN
WITH EGG ON EDGE
OF NEST

SOME INSECT CONTRASTS

How Some Social Wasps Differ in Their Life Habits from
Some of the Solitary Species

By PAUL GRISWOLD HOWES

Curator of Natural History, The Bruce Museum, Greenwich

PHOTOGRAPHS BY THE AUTHOR

An interesting subject for study in the insect world is that of contrasts which exist among individuals of the same order. In our own world we think of the human race as being made up of people more or less of the same general size, and rather like one another in general mode of existence; but in the world of insects we find startling differences even among single orders and families. One wasp, for instance, may be but an eighth of an inch in length while a near relative may be twenty times its size. It is as though you were five feet high and a relative living in another state towered one hundred feet above the earth.

We may divide the wasps into two great groups according to their habits. The solitary species, that is, those which do not live in colonies or divide the labor, and the social species that live in huge communities all working for the common

good of one nest, such as the paper wasps or hornets. Solitary species mate, and, as a rule, only the female wasp makes the nest and cares for the young. The male wasp rarely if ever lends a hand. In the case of social wasps his aid about the home consists of little more than his presence while the workers do the actual hard labor. In this respect, we see, they are indeed quite human.

Let us look at the life of the common paper wasp *Polistes*. In the early spring the female comes from hibernation in a fertile condition. She scrapes some pulp from a board or weathered lumber of some sort, rolls it into a ball, moistens it with her saliva, and flies to the selected nesting site. Here she flattens her material into ribbons of paper and from them constructs two or three tiny cells supported by a stem of the same material.

In each cell she deposits a white egg. When the eggs hatch she feeds the grub-



A STEPLIKE PAPER NEST

This jungle nest sheds the rain and protects the eggs and young

like young as carefully and thoroughly as any mother bird does her nestlings. She raises this first brood entirely by herself. After several weeks these youngsters are full grown larvæ and they spin silken caps over the ends of their cells, which have been increased in length by the mother as they increased in length themselves. In the cell-cocoons, the larvæ transform to pupæ and, a short time after this, hatch out as mature wasps.

The queen mother now has her first brood of workers, and from this time on she simply deposits eggs in the new cells as they are built by the workers. All the labor is now carried on by these worker wasps and, as the season progresses, many broods are hatched and the once tiny nest increases greatly in size.

As fall approaches, a brood of new queens and males are reared. These pair off before winter arrives and the fertile queens of these unions hibernate and

start the new colonies the following spring. All the workers die off by winter and only the new queens remain to carry on the race! Could any more remarkable story be told?

This brief life history of the paper wasp is a fair index to the general lives of the social wasps of our latitude, such as the "yellow-jackets," hornets, and other kinds that live in colonies. These are socially the most advanced species of the wasp world, that have learned the benefits of community life and the division of labor.

In the protection of the home, the social species excel. Their stings are well developed and ready for instant use upon an enemy. Solitary species seldom sting an intruder about their homes. They reserve this stinging power for preparing provisions for their offspring. Social species chew their prey into suitable porridge for their young.

A NEST OF *ZETHUS GENICULATUS*

Green strips of vegetable matter fashion this suspended wasp's nest

In complete contrast to the life habits of the paper wasp are those of the grasshopper wasp, a solitary species of the Eastern States.

The female wasp seeks out the common long-horned grasshoppers, those bright, grass-green fellows with the long antennæ that are numerous in summer. When she finds the hopper, she swoops upon him and stings him into almost total paralysis. This treatment does not kill him, however, but simply leaves the victim helpless.

Although the weight of her catch is often considerably greater than her own, the wasp flies to the nest with it in many cases. This she accomplishes by dragging the heavy object up the stem of a tall weed, or a sapling if there be one near by, and launching herself into the air from a good height. If the 'hopper is very heavy, she drags it the entire distance to her nest.



THE NEST OF A SOUTH AMERICAN WASP
This wasp's nest is made of clay molded until it is almost paper thin



THE HOME OF THE PAINTED-NEST WASP
Artistically finished and colored in brown, pink, green, and white

This wasp uses an abandoned carpenter bee's burrow in wood, or more often the perpendicular cracks between the shingles on the sides of a house. These cracks make convenient galleries in which to store the grasshoppers.

Two or three of the victims are dragged into the crack, which goes up under another shingle. On one of these a single egg is deposited and this young one, when it emerges, eats the living but helpless grasshoppers and takes care of itself entirely until it reaches maturity.

Each group of grasshopper provisions is separated from the next by partitions. Usually wasps use mud for this purpose, but this interesting insect carries long strips of grass to the nest and rolls them up into neat wads; thus the different cell inmates are prevented from mixing.

In South America, the solitary wasps are legion. The materials employed by them in nest construction are of very



A WASP WITH HER
GRASSHOPPER PREY
She stores her nest with
these insects and wads them
in with strips of grass



THE PRIMITIVE PREY OF
A SOUTH AMERICAN WASP
These Collembolids form the
food of the tiny wasp shown,
with its nest, at the top of
page 99. The pin in the
foreground shows how greatly
magnified this picture is

MICROSTIGMUS
A TINY NEST BUILDER

The insect and the nest are shown about ten times life size. The nest is suspended from the mid-rib of a leaf



A DIGGER WASP

The wasp is shown killing a cicada. Much enlarged

©by Paul Griswold Howes





ANOTHER MICROSTIGMUS NEST

This picture shows the nest enlarged about six times. The openings were made by the photographer in order to show the contents. This tiny nest is made of lichen fragments

great interest. Resins and gums are sometimes used, and this makes tough, water-proof houses that withstand the heavy tropical downpours of the rain forests of the Amazon Basin.

Moss, lichen, and hair are also used by some tiny species. One abandoned nest, the most remarkable ever found by the author, was of paper, with its surface studded with tiny sheets of an almost transparent substance that admitted light into the nest galleries. This nest, however, had belonged to a social species, probably *Polybia* or *Stelopolybia*. It reminded me of a factory, with its well lighted interior.

In the tropical nests one finds interesting protective methods in use. Some of the nests are suspended on long, sticky threads twelve to fifteen inches in length, so that the nests bob about in every breeze. Others are covered with pointed spines

and some have holes in the sides through which the inmate may plunge its sting as though a tiny warrior were inside with an ever ready bayonet!

These are interesting cases, but to illustrate the really tremendous contrasts



A HORNET'S NEST UNCOVERED

The paper cells at the lower edge of this section of a nest contain an egg (at the extreme left) and two young, maggot-like creatures which are hornets in the making

that may be found, let me relate a few notes on the life histories of two solitary species, one the giant cicada killer of the eastern United States and the other the *Microstigmus* wasp of British Guiana, the most minute wasp I have ever found that builds a distinct and beautiful nest.

The cicada killer of the North is a huge species in black and yellow armor. It appears when the cicada commences to call in summer, for it is upon these big bugs that the wasp preys. Its nest is a deep burrow in sandy soil, a tennis court being a favorite building site. The

mound of excavated soil thrown out is large enough to be annoying to the owners of a court chosen for this purpose. The burrow is divided into branches which terminate in cells, and in these the paralyzed cicadas are stored for the young wasps to feed upon.

A single egg is deposited on each batch of provisions, which consists of one or two cicadas, and the cell is then sealed up with earth and abandoned. The young wasp hatches and cares for itself, emerging from its earthy prison the following summer.

The accompanying photograph of the

shows the insect and its home *about ten times life size*. It is hard to imagine so tiny a creature living and building its nest in the great jungles of Guiana, but it does, and is one of the most interesting of all solitary species. It is new to science also and the accompanying photographs are doubtless the first of a tiny creature that has been named *Microstigmus guianensis*.

The nests of *Microstigmus* vary in color and texture. Some are made of what looks very much like the hairs of caterpillars. Others are of bits of moss and lichen and all are suspended upon short or long stems of the same material as the nest. It may be that these different nests belong to different species, but the life histories appear to be the same. In the tiny nests are several divisions or pockets as shown in the illustration on page 100. In these the young are reared.



WASP EGGS

A photomicrograph showing the eggs in a paper nest, part of which has been cut away by the photographer. The texture of the insect-made paper is shown with unusual clarity

cicada killer is only about twice life size so one may realize what a formidable wasp she really is.

To see a great contrast in the same order of insects, it is interesting to compare the photograph of *Microstigmus* on her nest with the one of the cicada killer. This



LARVAL AND PUPAL STAGES

The paper nest has been cut open to show the developing young. The picture is somewhat enlarged and shows the fibrous paper as well as the larval and pupal stages of the insect

On the damp floor of the jungle, in moss or dead leaves, are numerous minute insects known as spring-tails or Collembolids. These strange little creatures are among the most primitive of all insects and they form the prey of the tiny wasp. It is very interesting and unique thus to find an individual of the highest order of insects preying upon one from the lowest. The entire drama in the minute nests of this jungle citizen must be watched through a magnifying glass!

The egg of the wasp is deposited upon a mass of the victims in the cells of the nest. It hatches in two days—and the grublike larva that results feeds for a week, completely consuming its food

stores. A few days after this the larva transforms to a pupa and the mature wasp issues from this form about two weeks later.

It is an interesting fact that while this wasp does not feed its young from day to day, it makes a number of cells and provisions them one at a time, living in the central gallery of the nest the while surrounded by progeny in various stages of their development.

The searcher, especially in the tropics, may find wonderful tiny creatures on every side, and to some it is these smaller folk, rather than the greater animals, that give zest to existence in the great open spaces of the earth.



THESE ANGRY INHABITANTS OF A DISTURBED
WASPS' NEST ARE READY TO DEFEND THEIR
HOME

AMERICAN MUSEUM EXPEDITIONS AND NOTES

EDITED BY A. KATHERINE BERGER

It is the purpose of this department to keep readers of NATURAL HISTORY informed as to the latest news of the Museum expeditions in the field at the time the magazine goes to press. In many instances, however, the sources of information are so distant that it is not possible to include up-to-date data

EXPEDITIONS

EXPEDITION FOR LOWER CRETACEOUS DINOSAURS.—Barnum Brown and Mr. P. C. Kaisen left New York the middle of July to continue the work started in 1931, chiefly on the Crow Indian Reservation of Montana and in the Big Horn Basin of Wyoming. At Billings, Montana, they were joined by Mr. Darwin Harbicht of Ingomar, Montana, and the party first prospected the Cloverly Beds within the Basin. These strata for the most part were found to be barren, but at one place, twenty-five miles northeast of Greybull, Wyoming, two sauropod specimens were located close together, extending under a heavy ledge of sandstone, and were prospected. They are connected, uncrushed, and perfectly preserved, but, because of the extensive work necessary to excavate, were covered and will be collected next year.

The party then proceeded to Beauvais Creek on the Crow Indian Reservation, where nine skeletons were collected in 1931, and continued work in that vicinity. The material obtained this year includes a complete *Camptosaurus* skeleton of medium size, encrusted with limonite, to be exhibited in a large panel group, and a large incomplete *Camptosaurus* skeleton that will be prepared as a free mount.

The rarest specimens in the collection are plated dinosaurs of which there are four individuals representing three genera. One of them, referred to *Nodosaurus*, is an almost complete skeleton with all four limbs present but lacking the skull and anterior cervical vertebrae. It is thought that this can be exhibited as a free mount. This animal was about twenty feet in length, five feet in height, and seven feet through the body from point to point of the ilia, with a short, pointed tail. The body was protected by thick dermal plates, some flat, others ridged, and the smaller ones marked by a pattern that resembles woven cloth.

Another rare specimen is an incomplete skeleton with a large part of the internal skeleton present in solid sandstone with all of the dermal

plates in position, ranging in size from a pin-head to plates four inches across. All plates are flat or of low relief—a pattern that is quite distinct from any other specimen secured in this horizon, and resemble those of *Stegopelta* described from the later Niobrara Cretaceous.

A skull and jaws of *Hoplitosaurus* and an incomplete skeleton of the same genus were collected, and two other skeletons were located toward the end of the season but were not prospected.

This collection is of great importance as it represents a heretofore little known fauna intermediate in age between the Jurassic and Upper Cretaceous.

So far fourteen skeletons have been obtained from these Basal Cretaceous Beds, and it is planned to continue the work in the same region next year.

THE WHITNEY SOUTH SEA EXPEDITION.—The expedition is at present engaged in an ornithological exploration of the Bismarck Archipelago. Since this group consists mainly of large islands, the use of a ship was found unnecessary and the schooner "France," which had served the expedition since 1922, was sold early in 1932. The first place to be visited was New Britain, from which island Mr. William F. Coultas, now in charge of the expedition, has sent some valuable collections. These contain among other rarities two specimens of *Tyto aurantia*, a rare barn owl previously known only from three or four specimens, and not yet represented in any American museum; of a small hawk, *Accipiter brachyurus*, so far known only from the type in the British Museum, three specimens were sent; also four specimens of *Ortygocichla*, a genus of babblers endemic on New Britain.

In the meantime, Mr. Coultas has undertaken an exploration of the central mountain range thus far never visited by any naturalist. A cable, received by the Museum on December 12, 1932, announced the successful completion of this inland expedition and promises several new species.

The working out of the collections made in Polynesia by the Whitney South Sea Expedition is progressing favorably, and a complete revision of the Polynesian flycatchers is in preparation.

EXPEDITION TO NEW GUINEA.—On January 19, Mr. Richard Archbold, research assistant in the department of mammalogy of the American Museum, sails for New Guinea with Mr. A. L. Rand. At Port Moresby they will be joined by Mr. L. G. Brass, who is now engaged in collecting birds on the Solomon Islands. The expedition party will then undertake field work in New Guinea, and expects to spend about a year in collecting mammals, birds, reptiles, amphibians, and fishes. Many of these will come to the American Museum. Plants also will be collected for the New York Botanical Gardens.

Mr. Archbold and Mr. Rand in 1929 and 1930 carried on extensive collecting work on the Island of Madagascar.

PHIPPS-BRADLEY EXPEDITION.—The first shipment of specimens was recently received from the Phipps-Bradley Expedition. It includes a splendid series of 260 small mammals from Angola, and also an African buffalo skull left at Chitan by Herbert Lang in 1925. Collections were made on the Coporolo River 100 miles to the southeast of Lobito, Chitan, and 50 miles east from Andulo in Central Angola. In a recent letter from Mr. Bradley he states that the expedition will collect at Mulando, a deserted village on the Cunene River, as long as the rains will permit, and then go to the edge of the Mosamedes desert.

ARMSTRONG SANTO DOMINGO EXPEDITION. Early in November, William G. Hassler, last member of the expedition to leave the field, returned with nearly 200 live lizards and snakes, as well as the large collection of preserved material taken during the trip. An account of the expedition's experiences will appear in a later number of *NATURAL HISTORY*.

ARCHÆOLOGICAL COLLECTIONS FROM VENEZUELA.—Early in December twelve cases of archaeological material arrived at the American Museum from Venezuela, which was excavated by Dr. Wendell C. Bennett while sojourning in that country during the past summer at the request of Rafael Requena. This material is now being cleaned and classified in connection with research work in the Venezuelan field.

COLLECTIONS FROM LIBERIA.—Dr. G. W. Harley and Mr. Alfred Tulk of the Methodist Episcopal Mission in Liberia have gathered to-

gether and sent to the American Museum a most interesting miscellaneous collection of fishes, reptiles, amphibians, and insects. Doctor Harley and Mr. Tulk have done their work under great difficulty, as they are so handicapped by lack of funds that even the shipment of the specimens presented a grave problem. However, since becoming interested in the Museum when on a visit to New York about a year ago, Doctor Harley has devoted as much time and energy as possible to this work. It is his desire, if at some time a fund of a dollar a week could be obtained for the purpose, to have a native boy assist in his endeavors. This would make possible also a proper collection of small mammals and birds.

ASTRONOMY

THE astronomical talks which have been given under the auspices of the Amateur Astronomers' Association for the last two years are being continued this year over Station WOR, on Saturday afternoons from 5:05 to 5:15. These talks are on popular astronomical subjects and have attracted a great deal of interest in the past.

FROM December 19 to January 8 the Amateur Astronomers' Association held an exhibit in Education Hall, at the American Museum of Natural History, of material concerning the total solar eclipse of August 31, 1932. Many photographs, transparencies, and paintings of the eclipse were exhibited. This exhibit was viewed by large numbers of people, including visitors to the Museum from the various colleges and universities, whose vacation periods fell during this time.

THE meetings of the Amateur Astronomers' Association continue to be held on the first and third Wednesdays of each month, and all those interested are most cordially invited to attend. Notices of these meetings are given in the daily papers.

CONSERVATION

ALASKAN BROWN BEAR AND EUROPEAN BISON.—In the report of the executive committee of the New York Zoological Society to its board of trustees on October 20, the following statements on the conservation of the Alaskan brown bear and the European bison were made by Chairman Madison Grant:

"Your chairman has continued his efforts to attempt to find a solution to the pressing problem of preserving the Alaskan brown bear from extinction. There seems to be a reasonable prospect of securing Admiralty Island or a substantial part of it as a sanctuary for this splendid animal. The Island is particularly adapted for

the purpose, in locality, natural conditions, and food supply.

"The situation with regard to the restoration of the European bison, which was the object of Dr. Blair's mission to Europe in the summer of 1931, is progressing. A prospective site in Upper Bavaria has been selected for the proposed park and the Bavarian authorities are prepared to lend assistance to the extent of placing the grounds at the disposal of the Wisent Society without charge, and of donating the lumber for the fencing of the enclosure and the construction of corrals, shelter houses, and feeding stations. The Director of the Munich Zoological Garden will assume the duties of supervision without charge. As a beginning it is proposed to stock the park with one bull and two cows. These animals will be pure-blood stock since the Zoological Society has made it clear that it will not support any cross-breeding experiments. One of the cows will be loaned by the Berlin Zoological Garden. The other two animals will be purchased if they are not presented. For this purpose it is intended to use a portion of the funds subscribed by the Zoological Society."

EDUCATION

CHILDREN'S SCIENCE FAIR.—The fifth annual Children's Science Fair of the American Institute was held at the American Museum from December 4 to 15. An ever-increasing interest in this opportunity for children of greater New York to display their work in science is shown by an increase over last year of forty exhibits entered as the work of groups of children and fifty-seven exhibits entered as the work of individuals. Plant and animal life led all other science subjects, while the next subject of great interest among the young exhibitors was physics. Biology, industries, and chemistry were also well represented.

Entries for the fair came from the boroughs of Brooklyn, Manhattan, the Bronx, Queens, and Staten Island. In the main they represented public and private schools, though Boy Scout Troups, Catholic Boys Brigades, and private clubs were among the exhibitors. During the twelve days it was on view, 37,363 people visited the Fair.

The Children's Science Fair, which has attracted the attention of leading educators throughout the world as a most valuable method of encouraging the study of science in secondary schools, is at the forefront of modern educational development.

THE MOTION PICTURE RESEARCH COUNCIL, an organization which has been doing important

research work concerning the influence and social value of motion pictures on children and adults, has recently appointed Prof. Henry Fairfield Osborn as vice-chairman of the council. Dr. George H. Sherwood, director of the American Museum, has been appointed on its national committee, and Mrs. Grace Fisher Ramsey, associate curator in education at the American Museum, has been appointed a member of its national advisory council.

NEW MOVEMENT IN ADULT EDUCATION.—New York is a city rich in opportunities for adult education, but up until this time, there has been no effective centralization of information about this work. Now, the Brooklyn Conference on Adult Education, the Council on Adult Education for the Foreign Born, and the New York Conference on Adult Education hope to fill this need. Through the development of a central information service, a weekly bulletin, and general publicity on adult education, they wish to stimulate the public and especially the unemployed, to a realization of the opportunities for education.

The American Museum of Natural History is one of the coöperating organizations and is represented in the Organizing Committee by Doctor Sherwood. The Museum has a growing program in adult education. It is hoped that this year will see new activities in this field.

BIRD WALKS.—From time to time nature lovers have asked if the American Museum could not give special nature walks. The Museum is glad to announce that arrangements have been made with Mrs. Gladys Gordon Fry, known to bird lovers and students as "The Bird Lady," to continue her outdoor courses on the birds and trees of Central Park, under the auspices of the American Museum of Natural History. An early morning group will meet at six-thirty o'clock on Tuesdays and Fridays, beginning April 4th. There will also be a nine-thirty o'clock group on these days. Each class period will be one and one-half hours in length. The fee for the course of ten lessons will be \$12.00.

At three o'clock on Tuesdays and Fridays, a children's group will meet. The length of these class periods will be determined by the age of the children registering. The fee for this course of ten bird walks will be \$10.00.

The rendezvous for all groups will be in front of the main entrance to the Museum, on 77th Street. Applications may be made to the department of public education, Room 306, in the School Service Building of the American Museum of Natural History, or by telephoning ENdicott

2-8500, Extension 181. Fees may be paid at the time of registration. Checks should be made out to the American Museum of Natural History and mailed to Dr. George H. Sherwood, Curator-in-Chief of the Department of Public Education at the Museum.

THE JUNIOR ASTRONOMY CLUB.—Sponsored by the American Museum departments of astronomy and education, the Club has recently extended associate membership to several groups in other cities. All associate members receive the *Junior Astronomy News*, a ten-page paper, written by the club members, as well as notices of any approaching astronomical event.

The members of an astronomy club in Findlay, Ohio, led by H. F. Hamilton, were enthusiastic Junior Astronomers last season and have renewed their membership. A group of students in Elmira, New York, under the leadership of Miss Mary A. Newsome, have taken twenty-one memberships. To far away Biloxi, Mississippi, the *News* takes word of astronomical activity to the Woodlawn Stargazers, sponsored by Miss Dabney M. Ewin. The Astronomy Club of Belmar High School, Belmar, New Jersey, under Miss Jennie Miller, also has been granted membership.

Observations of the August eclipse and the November Meteor Shower were received from many parts of the country through the Club's associate members.

THE BEAR MOUNTAIN TRAILSIDE MUSEUM, operated by the department of public education of the American Museum, ended its 1932 season on October first. During the period more than 300,000 contacts were made with the visiting public. The nature trails were extended and partly rebuilt. The Acorn Trail, leading through a rocky ravine at the Hudson's edge, was labelled with numbered signs referring to information contained in guide sheets. It proved a thoroughly satisfactory method of nature teaching and was used especially by groups of students with leaders.

The exhibits in the Trailside Museum were completely changed during the six months of operation. The leading display was one called, "The Story of Interdependence." This was designed to show interrelations of both plant and animal life and was developed in an evolutionary fashion, beginning with low forms of plants and extending through many different stages of advancement to embrace animal growth and dependencies. In connection with this exhibit was one of plant adaptations and another of plant classification.

Good fortune was experienced in the collection of animal life. As a direct result, the animal exhibits of insects, amphibians, fish and reptiles formed a truly representative cross section or living check list of creatures known to the Pali-sades Interstate Park.

Aid was offered to the five regional museums of the park and to many individual camps during July and August. Several nature trails were established by Trailside Museum staff members. The most interesting of these was one constructed for the Blind Player's Association in Suffern, New York. The trail was laid through a fine stand of hardwoods. The labels were first written on the location and then translated into Braille. Brass plates contained the messages to the blind. These were affixed to trees and posts to enable the blind children and adults to "read" as they walked along the path. Plans were made to extend this trail next year.

BROADCASTING BY AMERICAN MUSEUM

AERICAN MUSEUM BROADCASTS have been successfully carried on throughout early winter months, the speakers bringing to listeners throughout the country stories of the Museum's work in the field and in the laboratory, as well as talks of a more general nature. Among the speakers of the past two months over Station WRNY were C. H. Curran, William H. Carr, William G. Hassler, and Francesca LaMonte. On January 17 Albert Brand will speak about Bird Songs and on January 31 C. H. Curran on Facts About Insects.

From Station WABC over the Columbia Broadcasting System the following men spoke: Roy Chapman Andrews, Sydney Heilprin, Roy Waldo Miner, James L. Clark, William Hassler, and Robert T. Hatt. The program for the next two months is as follows: January 19, William H. Carr, "The Trailside Museum, Bear Mountain"; January 26, G. Kingsley Noble, "Modern Biology and the Origin of Species"; February 2, Wendell C. Bennett, "Anthropological Collections from Bolivia and Venezuela"; February 9, James P. Chapin, "Birds of Africa"; February 16, Barnum Brown, "Fossil Reptiles"; February 23, Clyde Fisher, "Astronomy"; March 2, Clark Wissler, "Indians"; March 9, Hawthorne Daniel, "Primitive Boats."

These talks are given on Thursday afternoons from 2:15 to 2:30 o'clock.

FOSSIL VERTEBRATES

THE SUPPOSED FOSSIL MARSUPIAL FROM AFRICA.—Newspapers and scientific news magazines have lately given much attention to the announcement of what is claimed to be the

first fossil marsupial found in Africa. The claim is of unusual interest because no marsupial, living or fossil, had ever been found in Africa, and even more so because it is supposed that this new form is most closely related to animals otherwise occurring only in South America.

The discovery in question includes two fragments of small fossilized lower jaws found in rocks of Pliocene age in Namaqualand south of Port Nolloth. The specimens were forwarded to Munich by Dr. W. Beetz and were studied there by Dr. E. Stromer, who has published a paper on them in the Proceedings of the Bavarian Academy of Sciences. Doctor Stromer named the new animal *Palæothentoides africanus* and concluded that it was a marsupial and most closely allied to the South American Cænolestidæ, an obscure family which has lived in that continent since the beginning of the Age of Mammals but has never been found anywhere else. Doctor Stromer also discussed the possible origin of *Palæothentoides*. While declining to draw any positive conclusion, he points out two possibilities: that there was some early migration route from South America to Africa, or that this new African mammal might be independently derived from early European marsupials.

In view of the unduly positive statements made regarding this discovery in the press, and even in the scientific press, it seems necessary to point out that it is extremely dubious. Without going into too great detail, the evidence that *Palæothentoides* is a marsupial is essentially the belief that it has four molars. But this is very uncertain, and judging from Doctor Stromer's figures and description, the present reviewer is inclined to believe that it really had only three molars and was not a marsupial at all. The supposed first molar has more the character of a somewhat molariform last premolar. Even supposing it to be a marsupial, its mooted relationship to the South American cænolestids is doubtful in the extreme. It lacks the most essential diagnostic characters of that group and is very unlike any known cænolestid. The whole question is most decidedly *sub judice* and does not warrant any definite conclusion without further evidence.

This is not said in criticism of Doctor Stromer, who has presented the evidence fully and in the most scientific and reasonable way, and who is not responsible for the sensational use made of his tentative opinions. Most of the accounts have even described "the enlarged lower incisors," which Doctor Stromer specifically states *not* to be enlarged and some have gone into some detail regarding features which are not known and cannot even be guessed. The publicizing

of this discovery is to be condemned as illustrative of a tendency to place before the layman not the sound and well based theories and facts of science, but its most tentative and dubious hypotheses. This is misleading to the layman, and dangerous and unfair to the scientist.

In correction of a further press statement (for example in *Science*, Supplement, Nov. 11, 1932, p. 11), "the oldest known marsupial skull" is not a skull but three lower jaws and some other fragments, they were not found "in Montana" but in Alberta, Canada, and they were not found "not long before the war" but in 1914, 1915, and 1928 respectively. The second and most complete specimen of this oldest known marsupial, *Eodelphis culleri*, was found by Barnum Brown of the American Museum staff and is preserved in this Museum.—G. G. SIMPSON.

HISTORY OF THE EARTH

VOLCANOLOGICAL MUSEUM AT ST. PIERRE.—The latest word from Mr. Frank A. Perret in regard to the Mont Pelée Museum at St. Pierre, Martinique, dated November 3, 1932, is that photographs of the temporary lake formed on Pelée by the blocking of the Clair River by *nuée ardente* materials will be accompanied by specimens of the water of this lake, with more of it held in reserve and at the disposal of visiting savants. It is proposed to illustrate the origin and formation of most of the volcanic products, and to accompany the photographed phenomena with the erupted products. Products of all types of volcanic activity will be represented, from Pacific, Atlantic, and Mediterranean vents, and ash of all kinds, from the glassy vesicles of Katmai, Alaska, to impalpable powders of the most acid types. Pelée's Hair, Pelée's Tears, Pisolites, bombs in variety, bread-crust pumice, lava molds, stalactites, obsidians, moldavites from outer space, free olivines and imbedded, free pyroxene crosses, thread-lace scoriæ, and a collection of old Neapolitan sub-soil lavas collected by Jervis and donated by his sister, are among the interesting exhibits. About a thousand photographs of volcanic phenomena will eventually be exposed.

Relics from St. Pierre, which was destroyed suddenly by a *nuée ardente* from Pelée in May, 1902, are still being found. They include all sorts of household effects, carbonized food materials, such as spaghetti, coffee beans, cacao, peppers, glass and table ware, coins, books, and other objects too numerous to mention. Cut-glass decanters with the necks melted were found, and perfume bottles with the liquid sealed within. A case will be devoted to objects

found in clearing the site of the museum itself. These comprise carbonized mangoes, remnants of the French flag, a rosary, an ancient key, and so on.

The traveler who visits this museum will find that the exhibits have a special appeal. Like at Pompeii, he finds himself immersed in a tragedy; there is human interest, a buried city, and in the distance he beholds the volcano whose eruption accomplished the ruin he sees all about. The interest in the St. Pierre catastrophe is infinitely more recent and intimately related to our modern life and institutions than is that of Pompeii. St. Pierre is also more closely and imperiously dominated by the imposing Pelée with its new dome, developed in 1930, pointing to the sky in still slowly rising spires of rock.

It is now apparent that there are many and very good reasons for believing that the chances of another destructive blast reaching St. Pierre are very remote. The violence of the 1902 outbreak was due, in large part, to the centuries of virtual blockage of the volcanic chimney which preceded it, in this respect resembling the case of Vesuvius in the destruction of Pompeii, which in the nearly two milleniums that have followed, has not again suffered. The fact that Pelée was also in eruption in 1903, 1908, 1914, and 1929-1932 shows that the volcanic vent has not been definitely closed and augurs well for St. Pierre, its people, its museum, and the absence of great danger from the volcano as long as this pulsatory activity continues.

Work on the main museum building is progressing, but additional funds are urgently needed. The museum is a part of an active volcano study now going on, and into which the visitor may enter to his heart's content. The erection of a belvedere and a telescope on top of the Museum building are contemplated. Plans also include the establishment of field stations on Morne Léonard and sub-stations on Petit Bonhomme, for facilitating access to the summit of the new dome, soon to be cool enough to visit. By removal of stones, a way up the Riviere Blanche valley is believed possible for a specially constructed volcano-climbing auto, which may be asked as a contribution to the work. Thus, excursions from the Museum to the field station may be made in less than an hour. Such a journey will include a trip over the ash fields of the avalanche valley, among the bombs and blocks to the very heart of volcano land.

—CHESTER A. REEDS.

MAMMALS

NEW BASE MAP OF CENTRAL AND SOUTH AMERICA.—No one would think that so simple a matter as the preparation of a base map on which to plot distributions of animals and birds, would present many difficulties or require much research. Yet Miss D. F. Levett Bradley, working under the supervision of Mr. R. R. Platt of the American Geographical Society, with the resources which that Society has kindly placed at her disposal, reports that in order to fulfill the requirements planned for the map (projection on a common meridian and the insertion of 2000, 5000, 10,000, and 15,000-foot contours), she has had to compile "literally from dozens" of supplementary maps. It appears that for generations custom has prescribed in atlases not only separation of the Americas at the Isthmus of Panama, but also employment of different meridians and an entirely different set of contours for the map of Central America from that used in South America. Thus in the "Times Atlas," which has provided the general foundation for the new map, one finds in Central America the contours 1, 2, 3, 4, 5, 6, 8 and 10 thousand feet, but in South America contours 1500 feet, 3, 6, 9, and 12 thousand feet. To overcome this difficulty, it has been necessary to consult supplementary maps of individual countries or smaller regions often drawn on a much larger scale than required. Sometimes two-fold reduction has been needed before the data to be obtained from such maps could be intercalated in the working drawings. To compile for the region of Southern Chile it was necessary to reduce the 2000, 5000, and 10,000-foot contours of the American Geographical Society's "Millionth" map to about one-tenth. For several regions such work has been unavoidable.

While originally designed for use of students of animal distribution working in the department of mammalogy of this Museum, it is expected that, presenting as it will old data with a new "angle," the new map will find a far wider sphere of usefulness.

It is of special interest that, at a time when scientific institutions are peculiarly short of funds, the American Museum is able to avail itself of the skill and experience of Miss Bradley, who comes to us as a special worker from the Emergency Work Bureau.—G. H. H. T.

MINERALS

AT the annual meeting of the Mineralogical Society of America, held at Cambridge, Massachusetts, December 28-30, 1932, Curator Whitlock of the department of minerals and gems



THE BEGINNING OF A DIVE IN BERMUDA WATERS
The bathysphere overboard on its way to a 2200-foot plunge

of the American Museum was elected to the presidency of the Society.

BATHYSPHERE EXHIBIT

BEGINNING on January 20 and continuing for a month thereafter there will be open to the public in Education Hall of the American Museum an exhibit of wide appeal, showing the results of four Bermuda oceanographic expeditions of the department of tropical research of the New York Zoological Society under the directorship of Dr. William Beebe. These expeditions have been financed chiefly by Mr. Harrison Williams and the late Mortimer L. Schiff.

Perhaps the most dramatic object in the display will be the bathysphere in which Doctor Beebe and Mr. Otis Barton, his associate in charge of deep-sea diving, recently descended 2200 feet beneath the surface of the sea off the coast of Bermuda. The bathysphere, which was invented by Otis Barton together with Capt. John Butler, is an enormous steel ball 4 feet 9 inches in diameter, with two windows of fused quartz and one of steel. One may enter it through a 400-pound door. It is attached to heavy wire cables by which it may be lowered into the ocean's

depths and raised again. Telephone and light cables provide communication with the outside world, while the explorer is hermetically sealed within the globe.

Doctor Beebe's experiences in this latest descent added considerable to his knowledge of the actual functioning of the light organs of the deep sea fishes that live below a depth of 1700 feet, where to human vision short light waves are inappreciable.

MEETINGS OF SOCIETIES

NEW YORK ACADEMY OF SCIENCES.—On the evening of December 19 the annual dinner and meeting of the New York Academy of Sciences and Affiliated Societies was held at the Biltmore in New York. On this occasion retrospects of past knowledge and present exploration of Central Asia were given by Henry Fairfield Osborn and Roy Chapman Andrews. Professor Osborn discussed the scientific knowledge of that region before the work of the Central Asiatic Expeditions which were carried on intermittently from 1916 till 1932, while Doctor Andrews summarized the results of the Central Asiatic Expeditions and emphasized their scientific importance.

At this meeting officers for the Academy were elected for 1933, with William King Gregory as president.

THE NINETEENTH AMERICAN GAME CONFERENCE.—The Nineteenth American Game Conference met under the auspices of the American Game Association in New York City, November 28, 29, and 30. Assembled were the representatives of state conservation departments, research institutions, sportsmen's organizations, farm interests, United States and Canadian federal officials concerned with game matters, and sundry individuals whose interests led them to participate in the discussion of game matters. The Game Conferences are open forums where all interested in North America's wild life resources may have a voice. The participants are, however, predominantly sportsmen, and the discussions, with few exceptions, center on the means of increasing and perpetuating such species as the gunners consider "game," with little regard for other species whose lives are closely associated with the chosen species. The dominantly fair and progressive attitude of the body is, however, indicated by their adoption in 1928 of a far-sighted position known as the American Game Policy, which, though based on the desire for satisfactory shooting, demands adequate protection for the carnivorous predators and censures exterminative and irresponsible "control" measures.

In the 1932 Game Conference there were general sessions in which topics of the broadest interest were considered, and there were also programs of restricted scope such as a game-breeding program, a water fowl symposium, and a game policy symposium. An analysis of the program shows the following distribution of papers and prepared discussions presented during the session:

Game farming, 26; political problems, 20; waterfowl, 14; upland game birds, 12; accounts of general research programs, 12; farmer-sportsmen relationships, 7; fish and fishing, 7; mammals, 4; the predatory cat, 1. These papers and discussions are published as the Proceedings of the Game Conference and are available to the many interested persons unable to attend the conference. The Proceedings constitute an interesting document as to the present attitude of the shooting public, and, on reviewing the papers, one finds some encouragement in the growth of an attitude among sportsmen of responsibility for at least part of the wild life, an attitude little in evidence at the beginning of the century.—R. T. H.

SCIENCE OF MAN

SKULL CASTS OF *SINANTHROPUS PEKINGENSIS*.

The American Museum is indebted to Dr. Davidson Black and to the Geological Survey of China for a series of casts of an adolescent skull of *Sinanthropus pekingensis*. The specimen was discovered in 1929 at Chou Kou Tien, near Peking, China, by Mr. W. C. Pei of the staff of the Survey. The casts have been beautifully made by Damon and Co. of London, and will be a priceless addition to the Museum exhibitions.

The skull is very massive, thick and low, with contours that are startlingly primitive. It approaches *Pithecanthropus erectus* but is somewhat more advanced in the development of the skull roof. It will be placed in the Hall of the Age of Man.

The following publications on this skull are of particular interest:

PAPERS FROM THE BULLETIN OF THE GEOLOGICAL SOCIETY OF CHINA, Vol. XI, No. 4, 1932:

BLACK, DAVIDSON. Evidences of the Use of Fire by *Sinanthropus*.

PEI, W. C. Notice of the Discovery of Quartz and other Stone Artifacts in the Lower Pleistocene Hominid-bearing Sediments of the Choukoutien Cave Deposit.

BREUIL, H. Le Feu et l'Industrie lithique et Osseuse à Choukoutien.

NEW PREPARATION STUDIOS FOR THE AMERICAN

MUSEUM.—In 1922 President Henry Fairfield Osborn and Director George H. Sherwood formulated plans for several new American Museum Exhibition Halls, including African Hall, South Asiatic Hall, the Birds of the World Hall, the Hall of Ocean Life, and others, which were subsequently to follow.

New wings were needed, which were to be built by the City, but to meet this intensive program of increased preparation and exhibition, Mr. James L. Clark was asked to join the Museum staff to take charge of the preparation work.

Work was carried on in the limited quarters then provided as studios and shops, but these were in small units, and the preparators carried on as best they could in rooms scattered from basement to garret through different wings.

Fortunately the building program provided for a new building in the northwest court, which would house a new heating and power plant on the first three floors, and on the upper three were to be new preparation studios. This building was completed in January, 1932, and shortly thereafter all branches of the preparation department were moved into these new quarters, for the first time in the history of the Museum concentrated as an efficient unit in exceptionally fine and perfectly equipped quarters, where all the work is now going on.

On the top floor of this new building is the spacious atelier, about one hundred feet square.

The roof carries three great skylights facing north, and running nearly the full width of the building. These provide ample light for all work, while the area and height permit a great deal of big work to be carried on. It is possible to mount several giraffes, elephants, and hippos all at the same time.

At present the large mammals for African Hall are being prepared, while manikins, molds, and other attendant work go on simultaneously.

Along the west windows three bird taxidermists prepare and mount specimens, while other craftsmen prepare small mammal skins and mount reptiles and other specimens.

A department carpenter takes up one corner with necessary wood-making machinery, while at the southeast end a service elevator for carrying groups and large single animals, serves all the floors.

The fourth floor is given over entirely to accessory and wax working, under the direction of the department's associate chief, Mr. Albert E. Butler. Here plants for exhibition groups and various wax models are made.

In the southeast corner, a large, well-supplied stockroom accommodates all necessary supplies under the care of an attendant. Large locker rooms are also on this floor.

The tanning department occupies the third floor. Here is up-to-date machinery, where the valuable skins for mounting are prepared, and those for the scientific study collections are tanned and put in a state of permanent preservation. Near by is a refrigerator, some forty feet square, where perishable specimens are held pending their study or disposition.

To the northeast is a large and most modernly equipped osteological room, where skulls and skeletons are cleaned and prepared for exhibition and collection.

Two artists' rooms are also provided on this floor, where creative and painstaking work can be executed in quiet.

These three floors constitute the studios and working quarters. On the second floor of the old Museum wing, immediately joining the entrance corridor to this new wing, is the main office of the department, centrally located between the halls under construction and the working quarters.

Just outside this office is a hall, devoted to semi-public exhibition, where the working scale models of new halls showing the architectural development and miniature models of groups themselves are planned and experimented with, to produce the best result in the halls under consideration.

Cases of artificial flowers and plants, whole and

in parts, show how these group accessories are made. Other exhibits demonstrate how a bird is mounted, and still others, how a small mammal is mounted, a skin tanned, etc. Molds and manikins of big animals show the technical side of this work, and completely finished animals, awaiting installation, are on view. Beautiful paintings, "field sketches," made for background studies, adorn the walls.

For the first time, this department has approximated a well centralized and organized unit to carry on the vast amount of highly specialized work, which ultimately brings new Museum halls into being.

BEQUEST

A BEQUEST of \$30,000 has been left to the American Museum of Natural History, in the will of the late William Colgate, who was a life member of the Museum.

THE EXPLORERS' CLUB

PROF. HENRY FAIRFIELD OSBORN has been elected an honorary member of the Explorers' Club in recognition of his distinguished service in the field of exploration and science.

The Explorers' Club has recently moved from the building at One Hundred and Tenth Street and Cathedral Parkway to beautiful new quarters in the Majestic Apartments at Seventy-second Street and Central Park West. An interesting part of the new rooms is an explorers' museum in which relics of famous expeditions and explorers who have been members of the club are on display. The map room contains cases showing maps made by men while in the field and those used by expeditions, and a general map indicating the location of members and expeditions on active work.

The Library, one of the most complete in America on the subject of exploring, occupies the mezzanine floor as well as other rooms and the books are readily accessible.

THE AMERICAN MUSEUM LIBRARY

AMONG the interesting items recently added to the Library the following are worthy of particular note:

Big Game Shooting in Africa, by Major H. C. Maydon. An up to date compilation of useful and detailed information for sportsman and explorer, each section of the country being dealt with by an authority of wide experience. In presenting this work to the Library Mr. Arthur S. Vernay added greatly to the Museum's expeditionary resources.

The Tailless Batrachians of the Japanese Empire by Yaichiro Okada. A comprehensive monograph of 215 quarto pages and 29

magnificent plates which deals with the systematic status and geographic distribution of the tailless batrachia known to exist in Japan. The Library is indebted to the Imperial Agricultural Experiment Station at Tokyo for this impressive volume.

Journal of the Anthropological Society of Tokyo Volumes I to XL. In adding this file to its collections the Library has brought to the United States the first complete run of a periodical which is rich in valuable information concerning early Asiatic tribes.

DURING October and November the following Bulletin and *Novitates* have been published by the American Museum:

BULLETIN

Vol. LXIII Art. 6. Hatt, Robert Torrens—The Vertebral Columns of Ricochetal Rodents.

NOVITATES

- No. 572. Brown, F. Martin—Pteridae from the Regions of Mt. Duida and Mt. Roraima.
 No. 573. Zimmer, John T.—The Central American Forms of the Muscician Wren, *Cyphorhinus lawrencii* Lawrence.
 No. 574. Goodwin, George G.—A New Squirrel from Guatemala.
 No. 575. Simpson, George Gaylord—Some New or Little-Known Mammals from the *Colpodon* Beds of Patagonia.

- No. 576.—Simpson, George Gaylord—New or Little-Known Ungulates from the *Pyrotherium* and *Colpodon* Beds of Patagonia.
 No. 577. Simpson, George Gaylord—*Cochilius volvens* from the *Colpodon* Beds of Patagonia.
 No. 578. Simpson, George Gaylord—Skulls and Brains of Some Mammals from the *Notostylops* Beds of Patagonia.
 No. 579. Tate, G. H. H.—The Taxonomic History of the South and Central American Cricetid Rodents of the Genus *Oryzomys*.—Part 1: Subgenus *Oryzomys*.
 No. 580. Tate, G. H. H.—The Taxonomic History of the South and Central American Cricetid Rodents of the Genus *Oryzomys*.—Part 2: Subgenera *Oligoryzomys*, *Thallomyscus*, and *Melanomys*.
 No. 581. Tate, G. H. H.—The Taxonomic History of the South and Central American Oryzomine Genera of Rodents (Excluding *Oryzomys*): *Nesoryzomys*, *Zygodontomys*, *Chilomys*, *Delomys*, *Phacomys*, *Rhacomys*, *Rhipidomys*, *Aycomys*, *Oecomys*, *Thomomys*, *Inomys*, *Apecomys*, *Neacomys* and *Scolomys*.
 No. 582. Tate, G. H. H.—The Taxonomic History of the South and Central American Akodont Rodent Genera: *Thalpomys*, *Deltamys*, *Thaplamys*, *Hypsomys*, *Bolomys*, *Chrocomys*, *Abrothrix*, *Scotinomys*, *Akodon* (*Chalcomys* and *Akodon*), *Microtus*, *Podoryzomys*, *Lenoxus*, *Orymyzomys*, *Notomys*, and *Blarinomys*.
 No. 583. Tate, G. H. H.—The Taxonomic History of Certain South and Central American Cricetid Rodentia: *Neotomys*, with Remarks upon its Relationships; The Cotton Rats (*Sigmodon* and *Sigmodontomys*); and the "Fish-Eating" Rats (*Ichthyomys*, *Anotomys*, *Rheomys*, *Neusticomys*, and *Daptomys*).
 No. 584. Zimmer, John T.—Studies of Peruvian Birds. VIII. The Formicarian Genera *Cymbilaimus*, *Thamniscus*, *Terenura*, *Pernostola*, *Formicarius*, *Chamaeza*, and *Rhynchotrichina*.
 No. 585. Osborn, Henry Fairfield—*Trilophodon cooperi*, sp. nov., of Dera Bugti, Baluchistan.
 No. 586. Anthony, H. E.—A New Genus of Rodents from Yucatan.

NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum:

Benefactors

Mesdames BARKLIE McKEE HENRY, G. MACCULLOCH MILLER, H. P. WHITNEY.
 Mr. CORNELIUS V. WHITNEY.

Patron

Lord WILLIAM PERCY.

Sustaining Members

Mesdames JOHN C. ATWOOD, JR., CASIMIR I. STRALEM.
 Dr. CHARLES A. ELSBERG.

Annual Members

Mesdames MAUD L. CARNRICK, LAWRENCE I. GRINNELL, E. ROLAND HARRIMAN, A. M. HYATT, S. R. INCH, WORTHAM JAMES, HELEN K. LIEBERMAN, ALAN D. MARKS, H. B. PIERCE, MARY M. STUART, F. ARTHUR WELLMAN, LOUIS WIRSCHING, JR.
 Misses E. M. HEISER, ALICE KAHN, MARGARET M. KERR, ALICE KIGGINS, MARIAN S. MACDOWELL, SELMA C. MAXIMON, FLORENCE M. PEPPER, NINA RHODES, BEULAH WING.
 Dr. THOMAS HORACE EVANS.
 Colonel LEOPOLD PHILIP.
 Messrs. CORNELIUS B. BOOCKOCK, OTTO BOSCHEN, EDWARD MARTIN BROWN, GEORGE W. CARPENTER, WILLARD H. CARR, GEORGE W. CODRINGTON, STEPHEN M. DRYFOOS, L. T. DUBOIS, MARK EISSNER, WILFRID GREIF, PHILIP M. HAYDEN, B. F. HERMAN, F. G. HERMAN, ROY R. HORNOR, GEORGE F. KURZMAN, HENRY W. LANG, JAMES B. LONG, HENRY R. LUCE, A. E. O'GORMAN, H. F. PAAR, HENRY PHILLIPS, WILLIAM B. POLAND, PHILIP SPALDING, PHILIP M. WASSERMAN.

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REVIEWS OF NEW BOOKS

"The New Conquest of Central Asia." By Dr. Roy Chapman Andrews and Others. Pp. I, 678, text figures 15, plates 128, constituting Volume I of *The Natural History of Central Asia*. Issued December 29, 1932, by the American Museum of Natural History, New York, from the press of G. P. Putnam's Sons, New York and London.

THIS, the narrative volume, is the third in order of publication of twelve quarto volumes comprising the final reports on the exploration of The Central Asiatic Expeditions in Mongolia and China during the ten years 1921 to 1930. Volume II, "The Geology of Mongolia" by Professors C. P. Berkey and F. K. Morris was published in 1927, and Volume IV "The Permian of Mongolia" by Professor A. W. Grabau in 1931. Other volumes of the series are in preparation and will be issued as soon as completed.

Volume I comprises fifty-two chapters with appendices and index divided into four parts as follows: Part I, "Explorations in Mongolia" by R. C. Andrews, forty-three chapters; Part II, "Explorations in China" by R. C. Andrews, C. H. Pope, W. Granger and N. C. Nelson, seven chapters; Part III, "Summary Statements" contains two chapters. One is devoted to "A Review of the Work of the Central Asiatic Expeditions" by C. A. Reeds, the other is given over to a discussion of "Unsolved Problems in Central Asia." It contains articles by C. P. Berkey, A. W. Grabau, F. K. Morris, L. E. Spock, H. F. Osborn, W. Granger, G. M. Allen, J. T. Nichols, N. C. Nelson, R. W. Chaney, C. H. Pope and R. C. Andrews. Part IV, "Appendices" includes the Bibliography, List of Publications of the Central Asiatic Expeditions, List of Contributors to the Central Asiatic Expeditions and an Index.

The greater part of the volume is devoted to Mongolia since the Central Asiatic Expeditions were organized primarily for exploration in that region during the summer season. The narrative account deals with the five field seasons, 1922, 1923, 1925, 1928 and 1930 in chronologic order. Those of 1924, 1926, 1927 and 1929 were not carried out owing to civil disturbances in China. Mongolia being too cold for field work during the winter, various members of the staff devoted this period to collecting in different parts of southern China where warmer climatic conditions prevailed. The collecting in China was carried on from 1921 to 1927. These separate explorations in Mongo-

lia and China have provided bases for arranging the volume into parts.

The expeditions were conducted as scientific reconnaissances with a highly trained scientific staff transported in a fleet of rapidly moving motor cars, and supported by a camel caravan. Intensive work was done in geology, topography, palæontology, botany, paleobotany, mammalogy, ornithology, ichthyology, ethnology and archaeology. All phases of the expeditions' activities are referred to in this volume. For instance, the customs of the nomadic Mongol people as related by Doctor Andrews are similar to those noted by the Abbé Huc, 1843-1846, in his travels across southern Mongolia. They are also like those described by the veteran Russian explorer N. M. Prjevalsky, 1870-1873, as he passed slowly in a camel-drawn Chinese cart from Kiakhta southward via Urga across the Gobi Desert to Kuku Nor and Peking. Prjevalsky, who during the years 1867 to 1888 likewise made five journeys into Central Asia, conducted scientific reconnaissances in geography and ethnography and made large collections of plants and animals. His books, published in Russian, with two translated into English, are highly interesting, when read in conjunction with the story of Doctor Andrews' present day explorations.

When Doctor Andrews made his first motor-car journey across Mongolia in 1919 he saw a vast country, but he could hardly have surmised the far-reaching scientific results of his large scale explorations of 1921-1930, which have already afforded material for 114 scientific papers and a series of memoirs. Previous explorers had reported the Gobi barren of fossils, but Andrews and his colleagues have discovered numerous fossil-bearing basins containing a superb record of animal life extending through hundreds of millions of years. The geologists of the Expeditions have collected an equally full series of rocks and outlined the entire earth history of north Central Asia. The archæologists of the Expeditions have found important evidences of prehistoric man, but much work, in this and other fields of science, still remains to be done.

The book is large, well printed, and includes in addition to three folding maps, more than 100

halftone illustrations, 10 of which are folding panoramic plates. Although the book contains much of scientific interest it has been so entertainingly written that it may be read from cover to cover with unflagging interest.

Copies of this volume and other Central Asiatic publications may be ordered from the Library, American Museum of Natural History, 77th Street and Central Park West, New York, N. Y.

—C. A. REEDS.

The Standard Natural History from Amoeba to Man, edited by W. P. Pyecraft. 942 pages, with twelve color plates and over 900 illustrations in the text. F. Warne and Co., London and New York.

HE who has not been a museum curator probably does not realize how many and how varied are the questions that the public asks us. A common, important, and often difficult query is "What book?" Usually it is a book on some special subject. If not, if it is "What single book will give me a reasonably clear idea of the whole animal kingdom?" I am now prepared to recommend the subject of this notice.

This "Natural History" is world-wide in its scope but, since the twelve contributors are English, it is not surprising that many of the illustrations are drawn from the British fauna. However, in a general book of even nearly a thousand pages the emphasis must be on the major groups, not on individual species, and the two sides of the northern Atlantic have much the same major groups. Furthermore, no American "natural history" that can compare with this has yet been written.

The book is "popular" in the sense that it deals with a popular subject in a readily understandable way. Even rather technical distinctions are made quite clear. It is not "popular" in the sense that scientific accuracy is sacrificed by either omission or commission to make a catchy story.

Some American biologists will probably feel that the idea of "adaptation" is given rather undue prominence but that is a matter of opinion. It is a good book and, since it does not quite fulfill its title's promise to include man, it may be read in all parts of our country.—F. E. LUTZ.

"The Structure of *Dinichthys*: a Contribution to Our Knowledge of the Arthrodira." By Anatol Heintz. *The Dean Memorial Volume*, Part IV.

IN memory of the late Dr. Bashford Dean, the first curator of herpetology and ichthyology in the American Museum, the Trustees in 1930 authorized the publication of *The Bashford Dean Memorial Volume. Archaic Fishes*. The main object of the volume was to describe the collections of very rare eggs and embryos of the most

ancient and primitive types of fishes still living, which had been collected by Doctor Dean, chiefly in California and Japan, and for which he had drawn a long series of beautifully executed plates in color.

Under the able editorship of Dr. E. W. Gudger four parts of the volume have already been published and several others are in progress.

The first part was a brief biography of Bashford Dean by William K. Gregory.

The second article, by Eugene Willis Gudger and Bertram G. Smith, described the segmentation of the egg of the California hagfish (*Bdellostoma stouti*), illustrated by photolithographs of Dean's colored drawings.

The third article, by J. LeRoy Conel, described the genital system of the same fish and discussed the curious fact that in some of the European hagfishes, but not in *Bdellostoma*, the gonads contain either functional testes and degenerate ovaries or the reverse. This was illustrated by four colored photolithographic plates of Dean's drawings.

The fourth and most recent of the series, by Dr. Anatol Heintz, is entitled "The Structure of *Dinichthys*, A Contribution to our Knowledge of the Arthrodira." There are ninety drawings made by the author, and nine plates reproducing photographs of the individual bones.

Dinichthys was an extinct type of giant fish-like vertebrates the fossil remains of which are found in the Cleveland Shale, of Upper Devonian Age. The big skull and jaw plates early engaged the attention of collectors, the first reconstruction of the skull and dorsal carapace having been published in 1875 by the geologist Newberry, Dean's professor at Columbia University. The scientific game of fitting these scattered pieces together was played by Newberry, Claypole, Dean, and many of their successors, but it has remained for the young curator of the Paleontological Museum at Oslo, Norway, after a year of intensive investigation of the collections left by Newberry and Dean, to evolve a new and definitive restoration of the skeleton of *Dinichthys*. By acquiring an irrefutable knowledge of the contacts of every bone on this three dimensional picture puzzle Doctor Heintz has not only succeeded in detecting radical errors in all earlier restorations but has also paved the way for his far-reaching conclusions concerning the relationships of the extinct group of Arthrodira to which *Dinichthys* belongs. For in this group Nature, while experimenting in the production of an efficient jaw mechanism, had far surpassed the structural level of the "jawless" Ostracoderms but had not yet reached the stage of evolving complex jaws from gill arches such as are to be found in the sharks.—W. K. GREGORY.

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HAWTHORNE DANIEL
Editor



A. KATHERINE BERGER
Associate Editor

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ROE DEER COUNTRY

This beautiful central Asian valley, almost lost amid the surrounding peaks of the Thian Shan, is the home of the illik, or roe deer, a few of which were collected by the Morden-Clark Asiatic Expedition for the American Museum

(See "*The Illik of the Thian Shan*," Page 175)

VOLUME
XXXIII

NATURAL HISTORY

NUMBER
TWO

MARCH-APRIL, 1933



FLOATING GOLD

The Romance of Ambergris

IN TWO PARTS—PART I

BY ROBERT CUSHMAN MURPHY

Curator of Oceanic Birds, American Museum

DEDICATED TO THE MEMORY OF FRANK WOOD, CURATOR OF THE WHALING MUSEUM,
NEW BEDFORD, MASSACHUSETTS. SEE NOTES, PAGE 227.

THE career of a museum naturalist is sometimes regarded as a dusty one, but among its amenities are the unforeseen calls of interested, curious, inquisitive, mysterious, or merely crack-brained individuals, who, by one pretext or another, find their way into his laboratory with something to be identified. A preliminary sifting out by the man at the information desk usually staves off the bearer of a rock crystal from disturbing the curator of insects, or the proud owner of a hippopotamus tooth from barging into the department of Peruvian archæology. However, there is no dependable bulwark against surprises.

The other day an attendant led into the ornithological sanctum a well-pleased youth carrying a large package, the contents of which he (the attendant) had sized up as the head of a bird. A monstrous beak did, indeed, protrude through the wrappings, but a loosening of the string disclosed the bleached, toothless, and weather-worn skull of a porpoise, picked up on the sands of the seashore.

"Very interesting," the ornithologist probably said, politely; "the skeleton of the forward end of *Tursiops truncatus*—no

doubt one that died—and the curator of mammals is just across the hall!"

But proceedings are not always so simple and overt. Telephone calls of a confidential nature may foreshadow the visit of the man with the dark secret. Letters of cryptic wording fail to reveal the precise nature of the what-is-it. Communications come from the possessor of the only nest and eggs of a humming bird ever found, or from the granddaughter of a clipper ship captain who has inherited the stuffed body of a *bona fide* mermaid of the China Sea. Such items are to be made the basis of transactions which will cost a tidy sum, but which will put the Museum definitely on the map.

While such opportunities come almost daily, it would be unfair to imply that even a tenth of the museum-minded public is self-seeking; on the contrary, the precious objects freely offered, declined with thanks, and carried away each year by their disillusioned owners would fill and sink the imaginary "Mayflower" that transported all the Colonial furniture to this continent.

Now of all the things presented for the



TOWING IN THE KILL

A sperm whale, floating barely awash, has been slain by a boat's crew from the brig "Daisy," and has just been made fast

inspection of that faithful servant of the public, the museum curator, the most romantic, and the least likely to be true, is ambergris. I say inspection, because identification is preconceived in the mind of the finder. His treasure, stumbled upon along the sea beach, recognized with the sudden surmise that dawns like knowledge from a previous incarnation, is encountered where ambergris belongs; it looks, and feels, and smells as ambergris should and, since it bears no resemblance to anything familiar, it follows that riches are already within his grasp.

However, confirmation is the capstone to personal certainty. "Some funny old cove at the Museum," the finder reasons, "will know all about it. Moreover, such a practical thought as trying to horn in on my profits would never enter his head. Those museum birds don't care about money, anyway. It will be a good idea to have it settled scientifically before I see

the man who buys the stuff for Coty."

During twenty years of museum work, the ambergris man or woman has sought me out approximately forty times. It is a pity that I neglected to make a record of each circumstance, because many details have slipped my mind. At any rate, if there were forty seekers, thirty-nine were doomed to disappointment. Of the lucky one, more later. As hinted above, the approach was frequently indirect.

"I have been told that you are the leading authority on whales," ingratiatingly writes a lady from a neighboring city. "Have you at the museum an example of ambergris in its crude state, as found on beaches? What is its general form and appearance, and is there any way that one can distinguish it positively from everything else?"

This is enough to assure me that the writer, or perhaps an imaginative boy in

her family, has brought home some spoils, and whether I am to see them or not depends upon my response.

Once a shabbily dressed man came to ask me whether it was possible nowadays to get a job on a whaleship. Long experience with the Treasure Island complex convinced me immediately that this visitor had no intention of going whaling. I answered his questions noncommittally, and let him do the talking. He was soon attempting to discuss the products of whaling, but of the source and uses of oil or bone he had no more idea than William Tell's son. Was there anything rare and valuable, he went on, that came from a whale? Spermaceti, I suggested. Maybe, but anything else?

Ambergris?

Ambergris! That's what he had been trying to think of. Does it come only

out of a whale, or doesn't it float around on the ocean? How many pounds of ambergris would be worth a million?

At this stage I abruptly invite him to produce his sample, and, with a sheepish grin, he fishes a bundle from his pocket. Inside the paper is a dingy handkerchief, and carefully wrapped in the latter a small, greenish-gray lump, more or less covered with sand.

"This has unquestionably been in the ocean," I remark, "for a lake would have dissolved it"; and, after a moment's scrutiny, I add, "it also came mostly from a whale. In fact, it is the remains of a bar of soap made from a little coconut oil and *much* whale oil."

The caller looks even more sheepish than before.

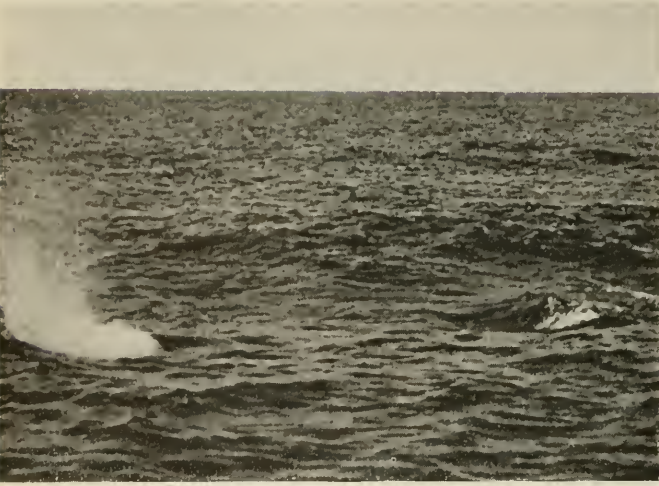
"Of course, I didn't suppose it was the real stuff," he explains, "but, all the



Drawn by F. L. Jaques

THE AMBERGRIS FACTORY

In the depths a bull sperm whale darts into an ink-clouded shoal of squids, which may be regarded in a sense as the raw material of ambergris



same, ambergris is worth watching for if you happen to be along the beach."

About half the ambergris brought to me has been soap, which dissolves only slowly in salt water, but wax, paint, tallow, blue mud, bits of decayed fish, water-logged wood, the residue of picnickers' lunches, coke, clinkers, and many other substances have also figured. The opening of a garbage-disposal plant on Barren Island vastly increased the supply in the New York region. So, too, the era of oil-burning steamers has spread upon our beaches an unpleasant largess, some of which is of a form to excite cupidity. It is not always easy to determine just what my visitor has brought, but in such instances the rigmarole of heating in a test-tube of grain alcohol, or of melting in a Bunsen flame, is ordinarily sufficient to convince the finder that his chances of making a quick fortune are even worse along the ocean

INHALATION

The spout is over, and the head is now rocking downward. The dilated spiracle, or spout-hole, can be seen on the far side of the snout

DE PROFUNDIS

After prolonged submergence, the sperm whale's spout sometimes bursts forth before any part of the creature appears

front than in Wall Street.

Yet why cavil at such an appealing human interest, for who of us is above it? Wealth has been gained through floating ambergris, not only on tropical shores but practically within sight of New York and San Francisco, and even northward toward the

polar seas, far beyond the range of the warmth-loving sperm whale which is the only producer of the coveted substance. Scarcely a season passes but what a more or less truthful account of an actual find appears on the front pages of the metropolitan press. A characteristic example is the following:

SEA GULLS GUIDE SAILOR TO \$12,500 AMBERGRIS

CAPE MAY, N. J., JULY 19.—Jeremiah Pratt was on watch last night on the deck of the Gloucester schooner "Mary Ann" when the clamor of sea gulls drew his attention to a cluster of the birds, vaguely visible ahead as they fought over a prize.

As the schooner overhauled the gulls, Pratt



SHE BLOWS!

The characteristic, rather slow exhalation of the sperm whale, with the head at the rising end of the "see-saw"

leaned over the rail with a boathook and retrieved their spoil, which proved to be a lump of ambergris, weighing twenty-eight pounds 2 ounces. The schooner was about fifteen miles off shore at the time. Pratt said that a New York perfumer had offered him \$12,500 for his find and that he intended to sell it, buy a poultry farm and retire from the sea.

From time immemorial, ambergris has had a fabulous value and, although its ancient uses have with one exception dropped away, it has not, like the bezoar stone or the alchemist's formula, ceased to be prized by the practical moderns. Ages before its true source was even remotely suspected, it was an important article of trade and a component of cosmetics, medicines, and love potions. Doubtless the exquisite vanity cases of Chaldean queens, recently unearthed and advertised throughout the world, were at one time filled with a derivative of ambergris. When, therefore, we see the contemporary lady of our delight spray-



ing her frock with a mist of Muguet, we can appreciate also the eternal verity in the line of the flippant archæological parodist:

I learned about women from Ur.

Ambergris and several of its supposed effects are mentioned in some of the tales of the Arabian Nights. The European attitude toward the commodity during the Middle Ages is well indicated in a text published as late as 1691, the "*Pharmacopœia Londonensis*." The learned author of this treatise on the "*Art of Healing and Praxis of Chymistry*" tells us that

It is a marine Sulphur, found at the Sea-shore, chiefly in the *Indies*, which breaks from Fountains and Caverns of the Sea.

It is gray, sweet and smooth; pricked with a needle it sweats out fatness, softens in the heat, and when moist appears black. . . . It is hot and dry, an excellent Corroborative; it is discutient, resolutive, alexipharmic, and analeptic; it strengthens the heart and brain, revives and recreates the spirits natural, vital, and animal. Its sweet Sulphur is

CLIPPER BOWS

Note the concavity on either side of the sperm whale's cut-water, and the mound of the inhaling spout-hole, which is asymmetrical and sinistral



an excellent Perfume; it is a good preservative against the Plague, and preserves the Spirits from infection.

This is followed by directions for the preparation of sundry horrible essences, through the mixture of ambergris, musk, and civet, which are to be sealed up in a vessel hermetically, and digested for forty days. The ripened blend, we are informed, perfumes forever what it touches, cures the headache, takes away defluxions from the eyes, comforts cold and aged people, prevents apoplexy and epilepsy, strengthens all parts of the body, and causes fruitfulness. In short, to the ailing individual of that day, ambergris was good for what you've got!

Earlier than the date of this profound book, apparently, the correct origin of ambergris had become at least suspected, for in the year 1672 an Englishman revealed the pertinent contents of a manuscript which had been found on board a captured Dutch East Indianman. This document stated that

Ambergris is not the scum or excrement of a whale, but issues out of the root of a tree, which tree, howsoever it stands on the land, always shoots forth its roots towards the sea, seeking the warmth of it thereby to deliver the fattest gum that comes out of it, which tree otherwise by its copious fatness might be burnt and destroyed; wherever that fat gum is shot into the sea, it is so tough that it is not easily broken from the root, unless its own weight and the working of the warm sea doth it, and so it floats on the sea. . . . If you plant the trees where the stream

sets to the shore, then the stream will cast it up to great advantage.

Lay off hunting for ambergris, boys; all you need to find is the ambergris tree!

When it became more and more evident that ambergris was, after all, indubitably found in the inside of a whale,

the die-hards trumped up another explanation. Faced with the stern facts, they assumed that the sperm whale was a hunter, rather than a manufacturer, of ambergris, and that he swam merrily about the broad ocean, gobbling up the treasure wherever he could locate it. In 1686, Dr. Thomas Brown wrote, in his description of a sperm whale cast upon the coast of Norfolk:



IN FULL CRY

Two of the brig "Daisy's" fleet of four whale-boats in pursuit of a distant school of sperm whales in the tropical Atlantic

In vain it was to rake for ambergrise in the paunch of this

leviathan, as Greenland discoverers, and attests of experience dictate, that they sometimes swallow great lumps thereof in the sea.

It remained for the empirical Quaker whalers of Nantucket to settle the question beyond doubt, as related by Doctor Boylston, a surgeon of Boston, about the end of the first quarter of the Eighteenth Century. Reports the doctor:

The most learned part of mankind are still at a loss about many things even in medical use, and particularly were so in what is called ambergris, until our fishermen of Nantucket, in New England, some three or four years past made the discovery. Their account to me is as follows:—cutting up a spermaceti bull-whale, they found accidentally in him about twenty pounds weight, more or less, of that drug; after which, they and other such fishermen became very curious in

searching all such whales they killed, and it has been since found in lesser quantities in several male whales of that kind, and in no other, and that scarcely in one of a hundred of them.

And so the matter rests, except that female sperm whales have since proved to share the honor with their larger mates. Encyclopedic works of much later date than the note of Doctor Boylston still continued to publish nonsense about a "fossil bitumen or nephtha, exuding out of the bowels of the earth in a fluid form and distilling into the sea, where it hardens and floats," but few have been misled. In the light of modern knowledge, which appears to be none too exact on the subject, ambergris is regarded as a morbid secretion of the liver or intestines of the sperm whale. Whalers have long agreed that it is the sick whales that yield the prize, and the legion of books on maritime adventure, credible and incredible, unite in stating that emaciated whales,

capable of supplying a minimum of oil, were nevertheless greeted with a warm welcome and a ready lance by the Yankee blubber-hunters, on the slim chance that the victim might more than make up from his in'ards what he lacked in his skin.

Out at Provincetown, on the hooked tip of Cape Cod, my late friend Captain D. C. Stull spent most of a long lifetime engaged in the stimulating vocation of a purchaser and wholesaler of ambergris and of porpoise-jaw oil. From the latter is refined the delicate lubricant for watches and chronometers. Whenever a herd of blackfish stranded anywhere along the northeastern coast of the United States, Captain Stull, who walked with a limp but who covered the ground more rapidly than most of mankind, was apt to be the first practical man on the spot, prepared to buy the animals for cash from fishermen or townships, and undertaking to



THE "DAISY"

Built at Setauket, Long Island, in 1872, this whaler long flew the flag of New Bedford owners. She was Doctor Murphy's home for a year's cruise during 1912-1913

tow all the objectionable carcasses safely out to sea as soon as he had removed the rich blubber of "junk and jaw," these being the only parts that yield the fine oil. In like manner, if a New Bedford whaler reported to her owners a haul of ambergris, Captain Stull would at once open negotiations, and would be waiting at the dock when the ship came home. Equally ready was he to deal with possibly lucky beach-combers of the sort mentioned at the beginning of my story, and his experiences in receiving bits of all the worthless substances that are buoyant in salt water were, naturally, far more diverse than my own. Most such he treated with a chuckle, and the untrusting reactions of persons who impugned his motives in telling them the bitter truth about their

discoveries, only added to his good-natured merriment. After all, the chap who appears with "genuine ambergris," whether pre-war or not, is to be received with only slightly more credulity than the inventor of a perpetual-motion machine. In either case the burden of proof is squarely up to the seller.

And so although watch-oil was his staple, Captain Stull obtained and disposed of a considerable quantity of ambergris during the course of several decades. The marketing was his own business secret. Because of the relatively minute amount of the extract required by all the perfume manufacturers of the world, the ambergris exchange has its own curious technique. Like the stock exchange, it is subject to more or less unpredictable

fluctuations. A large catch may cause a glut, with a corresponding drop in the current price. Therefore it does not always pay to find, or to admit ownership of, too much; you may get more for less. While Captain Stull was ever ready to buy, he did not always choose to sell, and how much of the strange material he may have had stowed away in his strong-box, nobody but he was in a position to know.

Captain Stull perhaps shared a belief in the general weak-minded honesty and total lack of workliness accredited to professional naturalists, for he was remarkably generous in turning over to me liberal samples of his choicest commodity. In fact, I have driven



READY TO LOWER

At the skipper's command, the cranes are swung back, the falls paid out, and the graceful whaleboats drop lightly from their davits to the water



CUTTING IN

The blanket-piece of blubber is being ripped from the carcass, and the officers are beginning to decapitate the whale with their cutting spades

away in my Ford from Provincetown with my pockets stuffed with small bottles containing a king's ransom, all to be picked over at my convenience. Fresh ambergris, old ambergris, the best grade of gray, the poorest of black, ambergris that was mottled like marble, ambergris that looked like old cheese and smelt worse, ambergris that had the traditional fragrance of ploughed earth—it was all mine to handle and section, to examine under a microscope, and to return at my own will. My efforts resulted more in the verification of well known facts than in making startling new discoveries, but there was one conspicuous exception. In a sample from a sperm whale that had been killed off the south coast of Haiti during the year 1912, I found several bristles which were recognizable as the cheek-whiskers of a seal! Subsequent comparison with museum specimens showed that these belonged to the excessively rare, if not

quite extinct, West Indian seal, an animal first met with by Columbus and long ago wiped out through most of its former range by insatiable hunters of oil and hides. Indeed, these whiskers from a whale's intestines constitute, so far as I have been able to ascertain, the latest zoölogical record of this little known seal. How long had they been encased in the waxy, preserving matrix of their strange tomb? The answer is bound up with two other still unsolved problems, namely how long does a whale live and how long may ambergris continue in its alimentary tract?

I need no wealth, and for my health

I feel no foolish fears:

I keep the rules we get in schools

And live a thousand years

sings the leviathan in an old ditty, but it doesn't necessarily mean anything.

Other relics of whale banquets impacted in Captain Stull's samples were



ELBOW-DEEP IN OIL

Spermaceti, from the "case" of the head, is the most valuable sperm whale product next to ambergris. The entire head of this baby whale has been hoisted on deck



THE BOARDING KNIFE

With his long-handled, two-edged sword the third mate deftly drills or severs the tough blanket of blubber as need requires

confined to the horny and indigestible beaks of squids or cuttle-fish, and to fragments of the internal shell or pen (what the canary bird eats) of the same creatures. Squids are ordinarily regarded as the exclusive food of the sperm whale, and their remains were the objects that originally gave a clue to the true source of ambergris. However, the ferocious potentialities of an aroused sperm whale have often been displayed to whalers, and we now know that at least one of the ocean-ranging monsters has strayed from the prescribed diet. An animal which could engulf a West Indian seal would have had no difficulty in taking in Jonah.

After the bits of squid beak had been picked out of the lots of ambergris that passed through my hands, the residue was an ash-colored or darker substance which softened in the heat of the palm, and melted, below the boiling point of water, into a yellowish fluid resin. At higher

temperatures it volatilized into white vapor. The dry lumps became electrified when they were rubbed slightly, so that they acted as magnets to re-attract all the squid beaks that had been separated from them.

The French term *ambre-gris* (gray amber) was first applied to distinguish the material from *ambre-jaune*, yellow or true amber. The respective animal and vegetable origins of the two were discovered only within modern times, whereas both were immemorially known as stuffs cast up by the sea. Ambergris is an opaque, waxy, laminated solid, having an odor suggestive of musk or benzoin. (Benzoic acid, one of its components, also gives the tart taste to cranberries). The aroma is as subtly pleasing to the majority of human beings as catnip is to all feline creatures, from tabbies to tigers. Yet, strange to say, it is decidedly offensive to a few persons, and this without



CUTTING BLUBBER

The spades are razor-sharp, and Herman Melville remarks that toes soon become scarce in the blubber parlor



BAILING THE CASE

The cistern of spermaceti from a large sperm whale is emptied with a thimble-shaped case-bucket while the huge head is partly buoyed up by the water

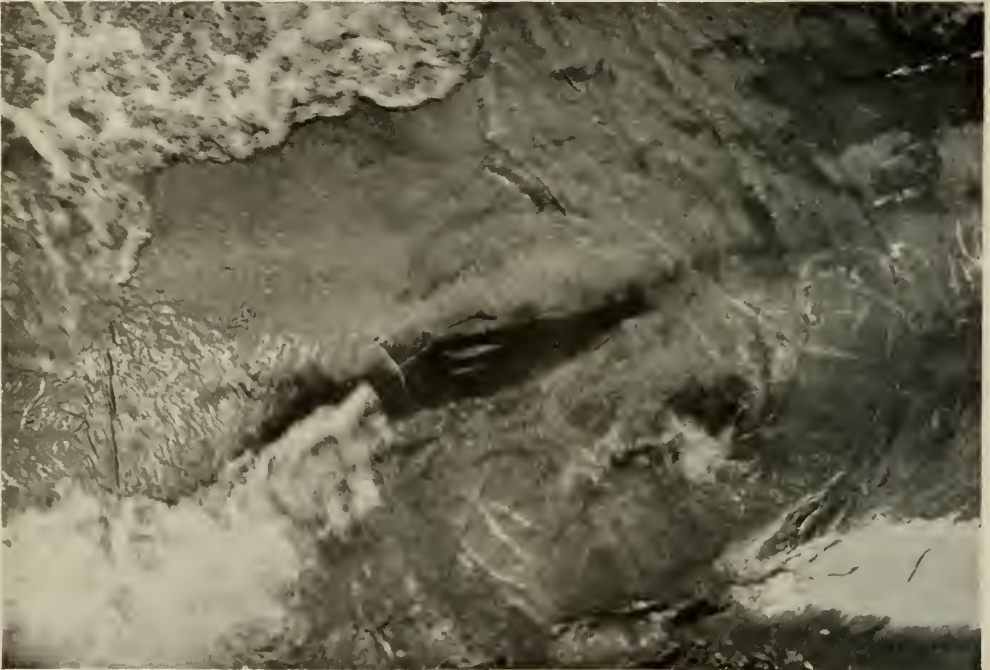
regard to the strength or purity of the solution.

Analyses of ambergris show that it contains a mixture of organic and inorganic substances. Among the latter are sodium chloride (ordinary salt), and phosphate of lime (perhaps derived from the hard parts of squids). The organic substances include alkaloids, acids, and ambrein. The last, which is its most characteristic constituent, is a peculiar fatlike compound, closely related to cholesterin. Since cholesterin is found in bile, the secretion of the gall-bladder, it may simplify our comprehension of ambergris to regard it as something related to gall-stones. The product so valuable to us may, therefore, be highly undesirable to the whale.

The formula of ambrein has been determined as $C_{23}H_{40}O$. It is said to make up from one-fourth to more than four-fifths of the bulk of ambergris, yet it

does not contain the whole secret, for although ambrein, in the pure form of white crystals, has a delightful odor, it will not of itself suffice in the manufacture of perfumes. Chemists believe that the unique properties of ambergris are due to the presence with ambrein of a benzoic ester which, in their parlance, is a compound ether made up of alcohol and acid radicles. (Aspirin is a familiar example of an ester). Since ambrein is separated out by hot ethyl alcohol, the perfumers avoid this dissociation by dissolving the natural product in cold alcohol.

It is common talk among dealers in perfumers' ingredients that ambergris possesses fixative qualities, that is, that it endows associated blossom odors in tinctures with a greater degree of permanence than they would otherwise have. The best conclusion drawn from much experiment, however, is that it really exerts no



A SIXTY-FOOT WHALE'S EYE

The great hulk floats like an iceberg—nearly all beneath the surface. The eye of this eighty-barrel sperm is scarcely larger than that of a cow



PEELING THE BLACKSKIN

Removal of the thin, tough blubber of the head exposes the case, which will next be split and bailed. Compare the contour of the snout with that of the living whale on page 121

appreciable influence of the sort, but that it merely "prolongs a certain note" due only to its agreeable and lasting bouquet. In other words, its real purpose may be said to be that of hoodwinking the olfactory sense of perfume users. After the delicate breath of roses or lilies of the valley has entirely evanesced, the exhalation of ambergris still remains, and possesses abundant charm of its own to compensate for whatever has been lost, or, perhaps, to prevent a realization that anything has been lost.

In the western world the use of ambergris in fine perfumes is the sole remaining reason for its high value, but in the Orient it is still prized for the spicing of wines and other ancient purposes. The Malays and the Chinese buy it eagerly, and the latter test its purity by scraping a trifle into boiling tea, in which it should dissolve completely, without leaving a fatty film.

Despite all that has been learned about

ambergris, there seems to be no absolute chemical or microscopic test for identifying it. It is to be judged in the manner of a connoisseur grading wines, by recognition of general appearance, bouquet, etc., rather than by rigid scientific standards. Even the squid beaks might not serve to distinguish it from other matter from a whale's insides and, moreover, these markers have been fraudulently mixed into tallow or tree-gum on more occasions than one! Experienced perfumers are, nevertheless, not deceived by natural or artificial imitations. When a specimen is shaved into cold alcohol in the proportion of about four ounces of the substance to a gallon of fluid, the odor is so characteristic, to one who has previously experienced it, that all doubt is dispelled. The mixture will stand a very large dilution, and when a little is added to rich perfumes it never fails to give a definite and appealing tang.

Black ambergris, occasionally found in whales, is believed to take its undesirable color from the sepia or ink of squids, the secretion that these free-swimming mollusks eject into the water to make a "smoke-screen" about themselves upon the approach of danger. Long immersion

in the ocean washes the dark pigment out of the ambergris, leaving the gray residue with its chemical properties unaltered. When pure, its specific gravity is never far from 0.90, so it is light enough to float buoyantly in either fresh or salt water, in which it cannot decay.

TO BE CONCLUDED



THE MAN IN THE MONKEY-BELT

A harpooner of the "Daisy" makes fast the case of an eighty-barrel bull so that it may be hoisted level with the deck



In the Northern Frontier Territory near the Abyssinian Border

SKY TRAILS IN AFRICA

The Equipment and Plans of the Latest Martin Johnson African Expedition

By MARTIN JOHNSON

FOUR expeditions to Africa, covering the better part of ten years, have taught us how to overcome many of the difficulties of photographing the natives and the animals of that fascinating continent. Consequently, now that we are about to undertake our fifth expedition, we are prepared to accomplish certain tasks about which we have often talked, but for which, heretofore, we have never been properly equipped.

Africa, as Carl Akeley long ago pointed out, has ceased to be the "Dark Continent," but that does not mean that railroads or motor cars will take one to just any portion of its vast interior. Even in the United States, where transportation has been developed to so extraordinary a degree, there are regions not easy of access, and this is infinitely more obvious in Africa, where roads so often deteriorate into trails, and where trails, very often, turn out to be very bad trails indeed.

The motor car, of course, has made many sections of Africa easily accessible,

but motor cars have their limitations. They do not ford deep streams very readily. They have a bad habit of miring down in wet weather and in the most discouraging localities, and swamps, as yet, just can't be crossed readily even in the best of Detroit's products. Mountain ranges, too, and jungles make touring difficult, and far too often we have found our motor cars utterly useless when some new and fascinating region beckoned.

For these reasons we have long wished for airplanes, and now, on our fifth expedition, we have them. Already they are completed, and our friends have laughed at us because of the "luxury" of their appointments. Furthermore, both Mrs. Johnson and I have learned to fly, and while we do not pretend to have attained any Lindberghian ability as pilots, we begin to feel at home, more or less, when we are at the controls.

It is, of course, quite a task to transport an airplane from New York to Africa, for we have no ambitions to be trans-oceanic flyers. At first it was our idea



THE TWO PLANES OF THE MARTIN JOHNSON EXPEDITION

Mrs. Johnson is shown standing between the two planes that she and Mr. Johnson have taken to Africa. Both planes are amphibians, one with a capacity of twelve and one of five passengers

to take the planes apart, to stow them in the hold of some one of the excellent liners sailing from New York to Egypt, and there to assemble them and fly south to Kenya Colony. We are, however, the proud possessors of two large amphibian planes—one with a capacity of twelve passengers, and the other with a capacity of five. It is possible to take them down and to set them up again, of course, but it is not a task lightly to be assumed. Consequently, when we learned that we could sail to Cape Town on a ship that could carry both our planes on deck, with a minimum of preparation, we changed our plans and decided to enter Africa at its most southern port, some 4500 miles distant, as that much overworked and very hypothetical crow flies, from the port at which we had originally intended to land.

However, such changes in plans are trifling when one has wings with which to fly, and the result is that before this

article appears in print, we shall have sailed from New York with our airplanes perched on deck, shall have landed at Cape Town, and shall probably long since have started our motors and soared away from the semi-protected waters of Table Bay toward the north and east on our air journey to Kenya Colony and the Northern Frontier, where we intend to set up a semi-permanent camp at the southern end of Lake Rudolf, there to fly and photograph to our hearts' content during the following year and a half or so.

Contrary to the ideas of many of our friends, we do not plan to try to photograph animals—at least to any great extent—from the air. If you have ever seen chickens run for cover at the approach of a hawk, you can visualize, with fair accuracy, what animals do at the approach of an airplane, and it is not at all our idea to make motion pictures of a lot of frightened and scampering beasts,

scattering at top speed as we roar about over their heads.

I have no doubt that we may occasionally get some worth-while shot from the air. We may, for instance, be able to make some interesting pictures of crocodiles and hippos beneath the surface of the water, for, from above, it is sometimes possible to see clearly through many feet of water. Our planes, however, are for transportation rather than for photography. They are equipped, of course, so that cameras may be mounted and used while we are flying. But they are also equipped so that we may fly across hundreds of miles of difficult country to some little visited lake, there to land and live on our planes for a few days at a time in our efforts to picture, by still and motion-picture cameras, as well as by sound-picture cameras, the wild life that we find.

I suppose that few of us are ever able

to do exactly as we might wish to do. Certainly that applies to me. For years Mrs. Johnson and I have been busy here and there taking motion pictures of animals, but, to tell the truth, I get a great deal more fun taking still pictures. However, one cannot find the time to do both, so I suppose I must continue to take motion pictures, although now the task is complicated by the additional necessity of making sound records.

However, Mrs. Johnson, and I are not to be alone this time. In addition to taking two excellent pilots—Captain Boris Sergievsky, who will return after he has delivered us safely to Lake Rudolf, and Vern Carstens, an expert pilot and mechanic,—we are taking Hugh Davis, who will devote his time to still-camera work. This phase of recording the wild life of Africa has never been carried far enough on any of our ex-



THE EXPEDITION PERSONNEL

From left to right are A. J. Sanial, who will work with the sound equipment; Hugh S. Davis, who will do still-camera work; Robert Moreno, assistant sound engineer; Martin Johnson; Donald Provost; Osa Johnson; and Vern Carstens, pilot and mechanic



GAME COUNTRY

Many parts of Africa are easy of access. Many other parts, however, are far less easy to reach, and airplanes will be of great assistance on that account



A CLOUD-COVERED PEAK OF THE "BACK COUNTRY"

Lakes abound in the region that the Johnson Expedition plans to visit, but roads and trails are infrequent. Thus the amphibian planes will be particularly useful



THE KAISOOT DESERT

This region, which lies to the north of Mt. Kenya, and about 100 miles to the southeast of Lake Rudolf, will probably be crossed many times by the Johnsons on their air trips to and from their base



IN THE NORTHERN FRONTIER TERRITORY

Near Lake Rudolf, which forms a part of the western border of the Northern Frontier Territory of Kenya Colony. With the lake as a base the Johnson Expedition will visit many outlying districts



A MONARCH OF THE WILDS

Although occasional photographs of animals may be made from the air, it is no part of Mr. Johnson's plan to attempt much by this method. The planes will supply transportation, principally, in order that new or little-visited regions may be photographed and new animal retreats recorded

peditions, and we have chosen Davis because of his excellence with still cameras. In addition to this member of our party, we will have with us Arthur J. Sanial, whose tasks, which are complicated, relate to the sound equipment, and Robert Moreno, son of Antonio Moreno, the motion-picture actor. He will act as assistant sound engineer.

Entering Africa at Cape Town we plan to fly north by easy stages, making side trips here and there to lakes or landing fields about which we may find material to photograph. Finally reaching Nairobi, we expect to complete our plans for our long stay in the vicinity of Lake Rudolf.

This lake, which is about 200 miles in length, forms part of the western border of the Northern Frontier Province of Kenya Colony, and extends for a little way into Abyssinia. Furthermore, within easy flying distance of Lake Rudolf are innumerable other lakes of varying sizes, some of which lie along the Abyssinian

border while others, such as Lake Paradise, where we have lived so long, are veritable wild animal havens about which the endless story of Africa's animals is forever being lived.

I have been asked just what it is we plan to do, and, if any exact plan is expected, I must plead ignorance of it. Roughly, of course, we know what we want to do, but we have always been creatures of impulse, ready to change our plans if something new and interesting should materialize. We hope, of course, to find some phase of wild life that has not been recorded. We hope to obtain more than usually interesting pictures of natives who are more than usually out of touch with white men. Certainly the region along the Abyssinian border may be depended upon to offer at least a little of that sort of thing. And animals, of course, are forever fascinating. We hope for something very striking from them. But we promise nothing, even to ourselves,



ZEBRAS AND GIRAFFES

The two planes used by Mr. and Mrs. Johnson have been painted in imitation of these two gayly decorated animals



HARTEBEEST AND ZEBRA IN TANGANYIKA TERRITORY

While this region will be crossed by plane on the way from Cape Town to Nairobi and Lake Rudolph, it is not likely that any considerable time will be spent here by the expedition

except, of course, that we shall once again revel amid the beauties of this vast land that we have come to love.

Whatever prompted us to do such a thing I do not quite know, but we decided to be quite nonsensical about painting our planes. The result is that mine is carefully painted with the colors and patterns that adorn that strangest of beasts, the giraffe, while Mrs. Johnson's plane, which she already calls Osa's Ark, is painted in the striking stripes of the zebra. Thus, for the next two years, two animals previously unknown to science will cavort about the skies of Africa,

bearing us here and there on our search for the pictorial record that constitutes our task and, no doubt, serving to originate, in the minds of the simple savages, some new and astounding story of huge birds colored like the giraffe and the zebra, which, bearing white men and a white woman within their commodious bodies, are likely at the most unexpected moments to drop from the skies upon the placid lakes for purposes understandable only to the white men themselves. And they, of course, as every African savage knows, are, in reality, just a little out of their heads, anyway.



THE JOHNSON HOME IN NAIROBI

"Darkest Africa" seems very remote indeed when homes such as this exist in a town where lions now and then walked the streets hardly thirty years ago



Keystone View Company

A Modern Archery Competition in Old Armor

KYU-DO

“THE WAY OF ARCHERY” IN JAPAN

The Technique, the Mental Training, and the Equipment Required for the Practice of Archery in the Land of the Rising Sun

By SHOICHI ICHIKAWA

THROUGHOUT the world the bow and arrow have played a highly important part in military history, and in Japan, more than in any other modern land, the bow still retains much of its old appeal. Perhaps the reason for this is the more prolonged period of feudalism, during which, down to the early part of the Nineteenth Century, the bow was a weapon intended for serious use.

Today, of course, archery plays much the same part in Japan as it does in Europe and America. Comparable as it is, however, to western archery, there are innumerable important differences, and with a technique all its own, with equipment that is radically different, it requires, or at least encourages, a mental

attitude that seems to have no parallel in the countries of the West.

Superiority of weapons has always been one of the deciding factors in warfare, even from earliest times. And it was, in part at least, the superior bows and arrows of the ancestral Japanese that made it possible for them to conquer, and ultimately to take over entirely, the present Japanese islands.

These forbears of the modern Japanese were, of course, not native to the present Japanese archipelago. There is some disagreement as to their exact origin, but whether they came from the Asiatic mainland or from the islands to the south, they were a more highly developed people than were the original Neolithic inhabitants of the land they were to conquer.



IN THE TEMPLE OF SANJUSANGEN-DO, KYOTO

In this illustration from an old book, *Buke-choho-ki*, published in 1694, of the temple shown below on this page, Toyotomi Hidetsugu, son of Taiko Hideyoshi, a famous dictator of old Japan, is shown trying his skill in the narrow gallery



HALL OF THE THIRTY-THREE PILLAR SPANS

This Buddhistic temple, built in 1266, contains 1001 images of the Goddess of Mercy. Its western veranda, 128 yards long, is a favorite place for archery contests because its limitations in height and width give splendid opportunity to test the individual skill of the competitors



YUBAHAJIME—THE INAUGURATION OF THE ARCHERY SEASON

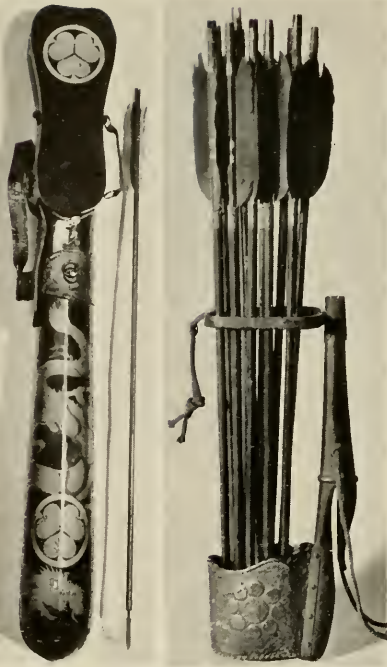
In the feudal period of Japan, during the early days of New Year, the opening of the archery season was formally celebrated in the Shogun's castle, which is now the present Emperor's palace grounds.
From a Japanese print



Keystone View Company

THE CEREMONIAL OF ARCHERY

A present-day reproduction of the old feudal ceremonial of archery. The costumes are patterned after the feudal period. This still constitutes one of the entertainments during a New Year's festival in Japan



QUIVERS

Several kinds of quivers were used for carrying the arrows, two of which are shown, the highly decorated lacquer case at the left, and the miniature holder at the right, made of leather and wood

Some time ago an iron arrowhead was found among many Neolithic remains in one of the shell mounds of Kiushū Island, one of the four major islands of the Japanese group. It is generally accepted that it was on this island that the earliest ancestral Japanese settled, and because this iron arrowhead was found under the rib bone of one of the skeletons, and because the shape of the arrowhead is about the same as we find in the protohistoric dolmens of Japan, it has been suggested that the ancient Japanese, owners, as they were, of such superior weapons, were thereby enabled to conquer the Stone Age aborigines of that part of Japan.

An ancient chronicle of Japan, known in Japanese as *Kojiki* and written 712 A.D., tells of the possession by the Japanese of really formidable weapons.

Amaterasu Ohmikami, the sun-goddess who is said to have been the original ancestor of the imperial family, when she prepared to meet her haughty brother, Susano-no-Mikoto, is described as "slinging on her back a quiver holding a thousand arrows, and adding thereto a quiver holding five hundred arrows, she likewise took and slung at her side a mighty and high-sounding elbow-pad, and brandished and stuck her bow upright so that the top shook, and she stamped her feet into hard ground up to her opposing thighs, kicking away the earth like rotten snow, and stood valiantly like unto a mighty man."

The old Japanese bow was, no doubt, a mighty weapon. It is related in Japanese history that in the year 322 A.D., the Korean ambassador brought an iron shield as his King's gift to Nintoku, the reigning emperor of Japan. Wondering as to its protective power, the emperor called his archer to test its strength, whereupon the archer, one Tatebitono-Sukune, shot through it with an arrow in the presence of both the emperor and the ambassador, much to the astonishment of the latter.



PROTOHISTORIC IRON ARROWHEADS

Specimens in the American Museum of Natural History

The construction and style of the bows used by these ancestral Japanese are not definitely known, though many names are given in early chronicles and poems for both the bows and the trees that supplied the wood. But though most of the trees are named, we are not now certain of the species to which they belong.

The Japanese bow is usually a large weapon, and even now, in certain of the Japanese temples, there are many medieval bows, kept as treasures, that measure from six to almost nine feet in length. It is interesting, too, to note that, whereas in England, where the bow reached so high a state of perfection, it always remained the weapon of the common people, in Japan the bow and arrow were regarded as sacred weapons, while "yumi-ya no michi," or "the way of bow and arrow" was used as an equivalent for "the way of Samurai," or knight.

We cannot tell, of course, whether these large bows were developed before or after the Japanese conquered their new homeland. In this connection it is interesting to note that when we analyze the Chinese character which, in her classic writing, denotes "Eastern Barbarians,"



SOUND-MAKING ARROWHEAD

Made of deer-horn, and almost identical in design with similar arrowheads common in Mongolia and formerly peculiar to Mongolians. This specimen is in the collection of the Imperial University of Tokyo

we find that it is made up of a combination of ideographs which, when separated, mean "large" and "bow." Incidentally, if we add the ideograph for "metal" at the left, the whole combination thus is made to mean "iron." This combination is illustrated on page 147, and it is interesting to wonder whether the "Eastern Barbarians" possessed iron before the Chinese themselves.

It is interesting to wonder, too, just who these "Eastern Barbarians" were. The distribution of the ancient Chinese race was, of course, quite different from what it is at present, and we do not know definitely who the users of the large bow were. They were not Chinese, certainly, and I suspect they had some cultural relations with the early Japanese tribes, but they undoubtedly belonged to the coastal regions of the mainland.



PROTOHISTORIC BRONZE ARROWHEADS
Specimens in the American Museum of Natural History



THE SALUTE

Mr. S. Kuwayama, sponsor of the Nippon Archery Club in New York City, illustrating one of the old methods of archery

It is not unlikely that both the bows and the technique of Japanese use are northeastern Asiatic in origin. One fact that points in this direction is that among certain protohistoric remains in Japan there have been found a number of turnip-shaped, sound-making arrowheads almost identical in design with similar arrowheads common in Mongolia and formerly peculiar to the Mongolians.

On the other hand, there is no evidence to support any contention that the Japanese bow is of southern origin. We know that the Malaysians did not use the bow at all, and in Formosa the present wild tribes use a very primitive bow, probably based on the bow used in China and Indo-China.

There are, in every land, where the bow has played an important part, many legends in which archery is a feature. Thus, in Japan, there are certain legends

that more or less parallel the story of William Tell, while history itself contains many accounts of exceptional archery.

Minamoto Yoshiie, the first Japanese archer of national renown, who lived in the Eleventh Century, once shot through three sets of strong armor as they hung



TAKING POSITION

The archer carries two arrows. One is held in the fingers of the right hand; the other is brought to position for sighting the target

from a tree. His descendant, Tametomo, an equally famous archer, distinguished himself in one of the battles of his day, by shooting through the armor and body of the opposing general, while the arrow, its force still far from dissipated, then mortally wounded the general's brother who, equally well armored, was standing just behind.

Tametomo was captured later in this war, and the enemy, after extracting one of the sinews of his right arm, exiled him to a distant island. Here he revolted, after his arm had healed, sank one of the

enemy's boats with his arrows, and escaped.

One of the beautiful romantic episodes of archery in old Japan is told as a part of the story of the battle of Yashima, which was fought between two clans, Minamoto and Taira, in the year 1185.

At the beginning of the battle the Taira army, which was in war boats, hailed the Minamoto army, which was ashore, and placed a fan, painted with the red sun on a golden background, upon the top of a pole erected in the bow of one of the war boats. The very young boy emperor, who

whereupon Nasu-no-Yoichi Munetaka, a young knight who was the most distinguished archer in the Minamoto army, mounted his horse, rode fully armored into the water, and intentionally avoiding the sacred picture of the sun upon the fan, struck the fan's rivet with his arrow and cut it free from the pole.

There are innumerable stories of a similar nature, but the space at my disposal is not sufficient to recount more of them here. Their very number, however, is evidence of the importance of archery in the earlier periods of Japan. For the reader interested in the subject of these accounts there are many volumes of Japanese history in which they can be found.

It is my task now, however, to give some description of the technique and the equipment requisite to a proper understanding of the character of Japanese archery.



AIMING

The bowstring is pulled back to a point behind the ear. The arrow rests on the thumb of the left hand and at the right side of the bow.

was on board, had certain ladies of the court among his attendants, and one of these, a young woman of unusual beauty, was posted beneath the displayed fan.

The young lady, pointing to the fan above her head, challenged the opposing army to display the prowess of its archers,



RELEASE

The arrow is released in such a way that the bow is deflected to the left and the string then hits the back of the left forearm.



SHOOTING IN A KNEELING POSITION

Mr. Kuwayama illustrating another one of the three positions used in archery, viz., standing, kneeling, and on horseback

According to Dr. E. S. Morse's classification, there are five methods of drawing and releasing the arrow. viz., primary, secondary, tertiary, Mediterranean, and Mongolian.

Of these the first three are primitive, and I shall pass them by. The method in use in Great Britain, in Europe, and in America is the Mediterranean, while the Japanese make use of the Mongolian method. The major difference between these last two lies in the fact that the Mediterranean method requires that the string be drawn by the first, second, and

third fingers, while the Mongolian method requires the use of the thumb for this purpose.

Archers using the Mongolian method usually put a ring on the thumb in order to prevent injury and to facilitate a smooth release, but Japanese archers use a peculiarly shaped leather glove which has a thumb and two or three fingers. Under the leather on the inside of the thumb is embedded a plate of bone or horn or ivory which, of course, serves the same purpose as does the ring.

The bows in vogue in modern Japan are slightly "in and out" in shape. They are made of two thicknesses of bamboo, divided by a thin strip of sumac wood, all of which are glued together while the natural outside of the bamboo shows at both the front and back of the bow. In addition to this lamination the bows are usually wound tightly

with rattan and colored with lacquer. The cross section is rectangular in shape. The usual length is seven feet two inches and the thickness may be one-half inch, three-quarters of an inch, or a full inch.

It may seem strange to the eye of a western

MEDIEVAL STEEL ARROWHEAD

From the Mosle Collection

The pierced characters read
"Have no depraved thoughts."

From Confucian Analects



大弓夷鉄

CHINESE CHARACTERS

Reading from top to bottom: Large, Bow, Barbarian (Eastern), Iron.
See explanation on page 143

archer, but the Japanese bow is so designed as to necessitate the placing of the arrow considerably below the center of the bow, while, to offset this, the upper limb differs considerably in strength from the lower, and the handle, or center of resistance, is about one third of the way up.

The strength of Japanese bows is measured by their thickness, which makes a direct comparison with western bows difficult. Mr. Saxton T. Pope, the well-known American authority on archery, measured a Japanese bow by western methods with the following result. The bow measured seven feet four inches in length, one inch in width, and a little less than three quarters of an inch in thickness. Mr. Pope found that this bow "pulls" forty pounds, and propels a target arrow one hundred and fifty yards.

The modern arrows are made of bamboo, and the feathers of eagles, hawks, cranes, owls, etc., are used. The construction of the arrow varies according to the objects to be shot, and the size also differs in proportion to the bow and to the man who uses it.

The targets used by the Japanese vary with

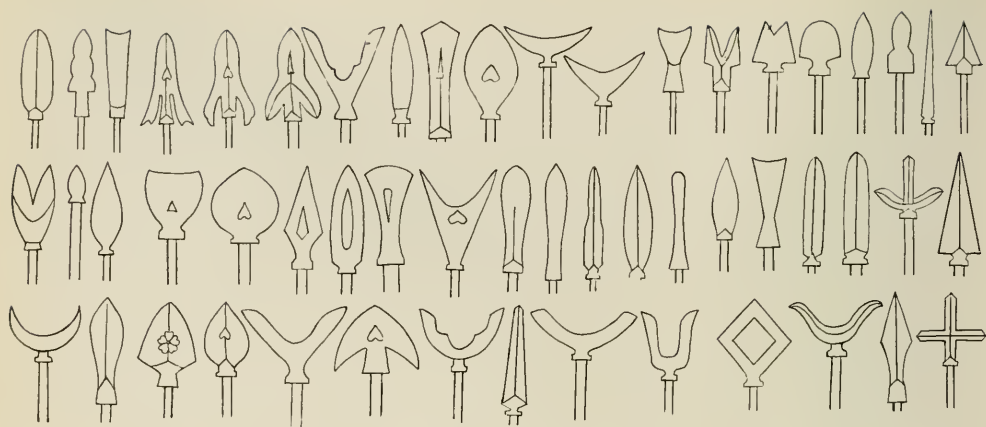
the different distances at which they are set up. At 15 ken (about 90 feet) targets may be circles $1\frac{1}{2}$ inches, 4 inches, 5 inches, 6 inches, 8 inches, or 14 inches in diameter. The largest of these is most commonly used, but many excellent archers shoot regularly at targets of the smaller sizes. The smallest is painted in either gold or silver and is called "kinteki" or "ginteki."

The targets used at the greater distances of 180 feet, 198 feet, and 300 feet are marked with circles 2 feet 6 inches, 3 feet 6 inches, and 5 feet 2 inches in diameter respectively.



A PERFECT RELEASE

The smoothness with which the arrow must be released is spoken of by the Japanese as being like the fall of a ripe persimmon from the tree



STEEL ARROWHEADS

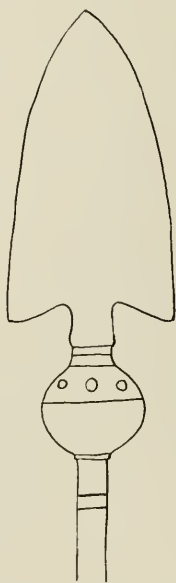
Showing the numerous types of arrowpoints in use in medieval times. Illustration from *Buke-choho-ki*, published in 1694

In the use of the bow, the Japanese draw the bowstring to a point behind the ear instead of to the nose, as western archers do, and discharge the arrow from the right side of the bow instead of from the left. In sighting, furthermore, the Japanese do not put the point of the arrow to the center of the target as many others do. Just above the handle is the "Surito," which is a short space usually wound with rattan strips, past the left side of which they sight to the middle line of the target, judging the trajectory by lining up the high point of the knuckle of the bowhand with the target.

The western archer uses an armguard on the inside of the bow arm, as a protection against the blow of the released bow-string, but the Japanese, who hold the bow with the left wrist bent to the right, do not require this guard. Instead, because they hold the bow loosely, the string usually strikes the *outside* of the bow arm, and in olden times they wore a small padded leather guard, called a "Tomo," on the outside of the arm

to prevent the bowstring from striking there.

This, no doubt, sounds strange to those who are not familiar with the Japanese method of holding the bow. So loosely is it held that the whole bow turns as a result of the released string, thus bringing the string against the back of the arm. The bow is mainly held by the second, third, and fourth fingers, in such a manner that the bow is prevented from turning toward the left. The first finger is left at ease, while the thumb is used only for pushing the bow, and the middle of the thumb as the arrow rest. There is a space left between the bow and the ball of the thumb which is popularly known among Japanese archers as the "one egg" space. Modern Japanese archers rarely use the "Tomo," for the strength of the target bow is seldom great enough to make the bowstring strike hard enough to cause discomfort.



OUTLINE DRAWING OF EARLY HISTORIC ARROWHEAD

With a sound-making bulb. In the Shosoin Collection. After Munro

In the city of Kyoto there is a temple called Sanjusangendo (Hall of the Thirty-three Pillar Spans), the western

veranda of which is 128 yards in length, with a ceiling 16 feet high. This veranda has been used from early times for archery contests, and many remarkable records have been made there. While 128 yards is not an excessive distance for an archer to shoot, it requires an exceptional bow to drive an arrow that distance when it can at no time in its flight go higher than 16 feet above the floor, owing to the roof, yet on one occasion, in 1686 A.D., an archer succeeded in sending 8133 arrows from end to end of the verandah in 24 hours (from sunset to sunset).

A similar building formerly existed in Tokio (or Yedo), and was used exclusively for archery. Here, in 1852, an archer discharged 10,045 arrows within 20 hours, and of these, 5383 flew true to the target.

Curiously enough, these trials of skill and endurance always began at sunset and continued until the appointed time the next day, while the archers, lighted by flaring torches, shot all night long.

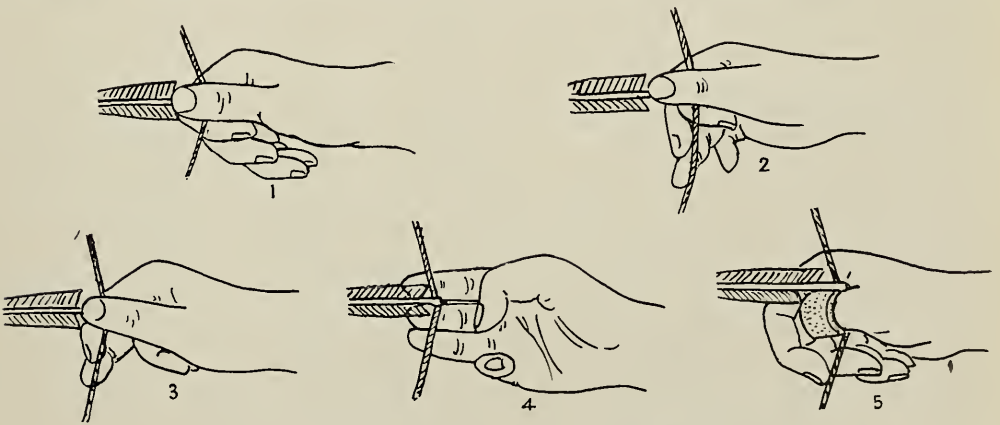
The English long bow, I gather, was rarely, if ever, used by equestrians. The Japanese, on the contrary, practiced equestrian archery even in ancient times. For this sport, which formerly, of course, was less a sport and more a military

accomplishment, there were three different kinds of targets. One of these consisted of three diamond-shaped targets in a row. Another was a hat woven of rushes and set on a post, while the third target consisted of released dogs turned into an arena of fixed dimensions. For this practice well-padded arrows were invariably used.

Modern archery in Japan is, of course, purely a sport, and its equipment is made to conform to the conditions of the day. The technique, however, and certain regulations are the same as have been used for many centuries. In many of the schools, too, archery is practiced as an aid to mental training.

An accomplished Japanese archer will tell us that after the proper technique is acquired, the successful practice of archery depends largely upon the archer's true mental poise, with the result that the mental, or rather the spiritual, side of archery is greatly stressed. Such an archer will despise the "shooting-at-marks-at-any-cost" practice, and will adhere strictly to the classical method.

Four principal schools for the teaching of archery exist in Japan today, of which the oldest is the Heki school. The founder was Hekidanjo Masatsugu, who lived



DRAWING AND RELEASING THE ARROW

Five different methods according to the classification of Doctor Morse. 1. Primary; 2. Secondary; 3. Tertiary; 4. Mediterranean; 5. Mongolian. The method in use in Great Britain, in Europe and in America is the Mediterranean. The Japanese use the Mongolian method



Keystone View Company

ARCHERY IN JAPAN

A group of boys in Tokyo practicing archery in the school grounds



©

JAPANESE GIRL ARCHERS

Archery in Japan is very popular among the students in the schools. It is included as part of the curriculum, for mental poise. The girls enjoy the sport as well as the boys

Keystone View Company

MINAMOTO
TAMETOMO

A descendant of Minamoto Yoshiie, who distinguished himself in many battles in his time. From an illustration in *Zenken-Kojitsu*

⑤



MINAMOTO YOSHIIYE

The first Japanese archer of national renown, who lived in the Eleventh Century. From an illustration in *Zenken-Kojitsu*

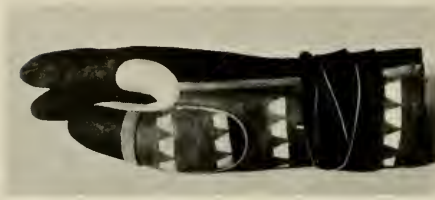


about the middle of the Fifteenth Century. He was a noted archer as well as a philosopher, and his teachings were probably inspired by the five cardinal principles of classic Chinese archery.

The teaching in the four schools differs only in minor details of technique, and all teach the "Sharei" or ceremonial archery," which tends to stress form and mental attitude. These "Sharei" practices have grown to be purely Japanese, although the idea was originally introduced from old China.

There is a very good description of archers in *Li-Ki*, one of the oldest books of China, which is supposed to have been compiled by Confucius. Translated it reads as follows:

"The archers, in advancing and in retreating, in turning or in making any other movement were obliged to conform to the ceremonial rules.



YU-GAKE

A glove worn by the archer when drawing and releasing the arrow. Under the leather on the inside of the thumb is embedded a plate of bone or horn to facilitate a smooth release

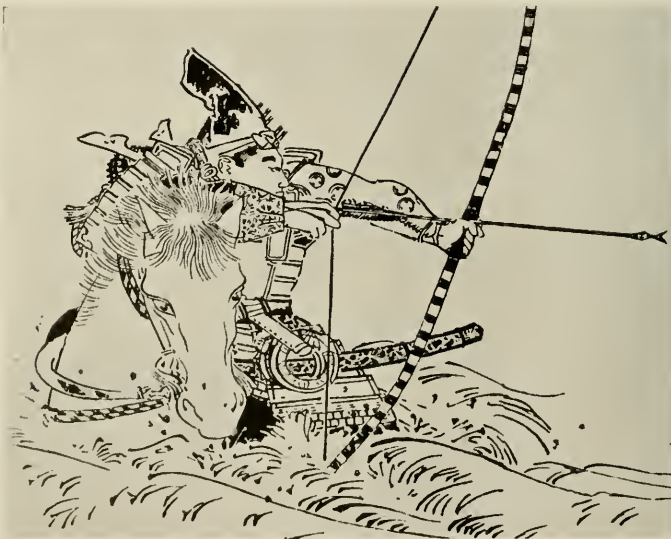
"He whose aim was straight, and carriage irreproachable, held his bow and his arrow with care and with a firm hand.

"In seeing him hold his bow and his arrow with care and with a strong hand, one might say, in

advance, that he would strike the goal.

"By the drawing of the bow one can know the virtue and the conduct of men."

I, myself, believe that a thoroughly worth-while practice, especially amid the hurry and the complications of modern life, is to stop, occasionally, in order to clear the confusion that must, from time to time, exist in one's mind, in order to regain some measure of its normal poise. And one way of attaining this most desirable end is to practice archery as it is practiced by the Japanese. Thus utilized, it becomes a most efficacious aid in the maintenance of that mental poise which, these days, is so much to be desired.



NASU-NO-YOICHI MUNETAKA.—FROM AN ILLUSTRATION IN "ZENKEN-KOJITSU"



Photograph from Ewing Galloway

Victoria regia Water-lilies in the Governor's Palace Grounds, Buitenzorg, Java

GIANTS AMONG THE PLANTS

Some of the Greatest of the World's Trees, Flowers, and Seaweeds

By CLYDE FISHER

Curator of University, College, and Adult Education, American Museum

AMONG the flowering plants we find tremendous variation in structure and size from the tiny duckweed to the gigantic California big tree. In the former (*Wolffia columbiana*), which I have found growing at the southern edge of Van Cortlandt Park, in New York City, the entire plant is about the size of a pinhead, while the latter is the largest and the oldest living thing. Among the non-flowering plants, the variation is perhaps as great, from the microscopic bacteria, the smallest of all plants, to the tree ferns and the great kelps.

It has always been a matter of interest to examine the largest natural objects,—the largest star, the highest mountain, the greatest river, the longest dinosaur,

the largest whale. Let us examine a few of the giants of the plant kingdom.

The giant water-lily (*Victoria regia*) from the Amazon is a striking plant, with large, beautiful flowers, and huge, round, floating leaves. The flowers, which measure from eight to sixteen inches in diameter, are nocturnal, opening on two successive days about five o'clock in the evening and remaining open until the middle of the following forenoon. The flowers are at first creamy white,¹ but change to pink or rose-red in twenty-four hours, and they exhale a delicious fragrance somewhat like pineapple. A development of heat, as much as 14° C. above the temperature of the surrounding air, together with a strong formation of



Photograph by Cowling

From Ewing Galloway

AN UNOPENED *RAFFLESIA ARNOLDII*

These flowers are parasites on the roots of trees. They grow in the jungles of Sumatra, and cannot successfully be cultivated owing to the fact that jungle conditions cannot readily be reproduced

carbon dioxide, has been observed during flowering.

In its native haunts the "queen of the water-lilies" grows in water from four to six feet deep, and forms great patches miles in extent, and it is perennial. The plant was photographed in its native habitat by Mr. Leo E. Miller, formerly a member of the staff of the American Museum, while conducting an expedition for its department of birds.

The most astonishing feature of the royal water-lily is the huge, round, floating leaves, which are often six feet or more in diameter, with the margin turned up at right angles to a height of from

three to eight inches, thus resembling an old-fashioned cake pan with straight-up sides.

In describing the leaves, Prof. H. S. Conard points out several remarkable features: "A single leaf, by its buoyancy, may sustain a weight of 150 or 200 pounds. Gurney at Tower Grove Park, St. Louis, covers the leaf with a large, round, quilted pad, then lays on an equally large frame of thin wooden slats, and on this a person can readily stand, as if in a boat. Not the least remarkable feature of these leaves is their rate of growth. Caspary found the maximum growth in length to be about one inch an hour when the leaf is just expanding; the surface increases four or five square feet in twenty-four hours."

There are two well-defined species of royal

water-lily, both of which are found only in South America. The northern one, which grows in the Amazon basin, is known to botanists as *Victoria regia*, and this is the form commonly cultivated in American gardens. The southern species *Victoria Cruziana*, is similar although quite distinct. It grows as far south as Paraguay and Argentina.

It seems certain that the South American Indians must have used, and still use this plant for food, as the North American Indians used both the seeds and the tubers of its relative, the yellow lotus or water chinquapin (*Nelumbo lutea*).

One of the largest flowers in the world is that of a species of *Rafflesia*. In the absence of a common name, it is customary among botanists to use the generic name, that is, the Latin scientific name of the genus, as the common name. About five species of rafflesia are known, all of which are found in Malaya. They are all parasitic upon the roots of plants related to our grapes, Virginia creeper, and Boston ivy. The rafflesia plants have no leaves.

The flower of *Rafflesia Arnoldii*, a native of Sumatra, is three or more feet in diameter. The flower bud, before opening, is as large as a large head of cabbage, which, by the way, is itself an enormous bud, although not a flower-bud. The upper side of the petals of rafflesia is brick-red with raised yellow spots; the lower side of the petals is dark brown. The central rough, fleshy rim or corona of the flower is yellow. The flowers are borne almost directly upon the roots of the host-plant. The odor, as described, must resemble that of our carrion-flower (*Smilax herbacea*), but is probably more intense. The offensive odor of the rafflesia and the *amorphophallus* probably attracts carrion-loving insects, which pollinate the flowers in their native homes, and thus bring about the production of seeds.

Amorphophallus is a genus of giant aroids from the tropics of the

Old World, sometimes grown as curiosities in greenhouses and occasionally in gardens. As indicated by the structure of the flowers, their closest relatives in this country are Jack-in-the-pulpit, skunk-cabbage, golden-club, and water arum or wild calla. On account of the disagreeable odor at the time of flowering, which probably resembles that of rafflesia, the *amorphophallus* are not commonly grown.

The flowers are like a huge calla except that the spathe and spadix are dark in color, as is often the case in the Jack-in-the-pulpit. There are many species of *Amorphophallus*, one of which, commonly known as Stanley's wash-tub, has a



Photograph from Ewing Galloway

RAFFLESIA ARNOLDII IN BLOOM

The full-sized blossom is about three feet in diameter. The pistils are whitish-yellow in color, and are surrounded by a zone of blue. The raised rim is yellow, while the five petals are brick red with raised spots of yellow, and the under sides of the petals are dark brown.



GIANT KELP ON THE
SHORE OF
VANCOUVER ISLAND

This species, *Nereocystis Luetkeana* sometimes called bull kelp or sea-otter's cabbage, is an annual which grows to a length of ninety or one hundred feet. It is rich in iodine

Photograph by C. J. Hibbard

on the Algæ, replied as follows: "I once lived for five years on the Pacific Coast where the big kelps are found, but that was when the world was younger and before I had

spathe nearly or quite two feet broad.

In *Amorphophallus Titanum*, the species figured in this article, the botanical description gives the following gigantic dimensions: tuber, 5 feet in circumference; leaf-stalk, 10 feet long; leaf-blade, 45 feet in circumference; spathe, 3 feet in diameter; spadix, 6 feet high. Bloomed at Kew Gardens, London, in 1890, the tuber dying thereafter. The native home of this remarkable species is Sumatra.

It is rather surprising to find that some of the large plants of the world are not flowering plants at all, but that some like the great kelps belong to a very lowly order, namely the seaweeds.

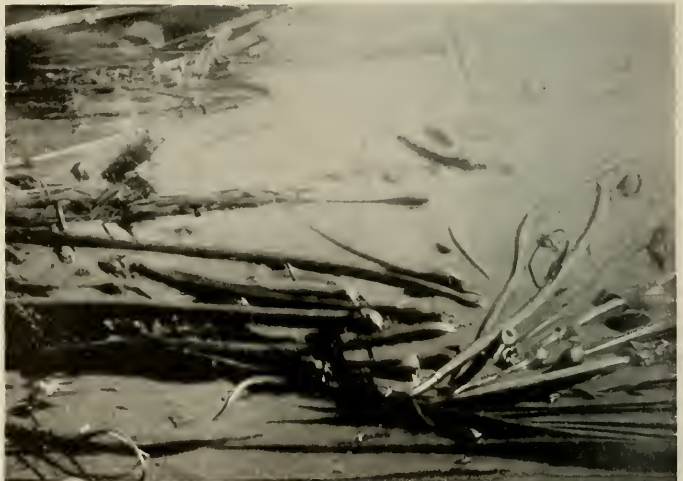
In response to an inquiry concerning the size of the big brown seaweeds, Dr. Marshall A. Howe, assistant director of the New York Botanical Garden and internationally known authority

begun to use a camera, so we have no real negatives from which prints may be made. However, I am enclosing two prints of the bull kelp (*Nereocystis Luetkeana*), which are not remarkably good, being copied from lantern slides.

"The Great Kelp (*Macrocystis pyrifera*) has been alleged to be of various extreme lengths, up to 1500 feet, but these larger figures are apparently all based on estimates of tangled mats, commonly seen from a deck of a steamer. So far as I know, the longest individual great kelp ever actually measured was about 150 feet long. This is a perennial, while the *Nereocystis* is an annual. A habit photo-

A HUGE BROWN
SEAWEED

A close-up view of the kelp pictured at the top of this page. It was taken off the shore of Turn Island, Washington. Government studies have demonstrated its value as a fertilizer as well as a source of iodine



graph of *Macrocystis* would not show very much."

These huge algæ grow only in the ocean, and they do not have true roots, stem and leaves, as most of the higher plants have. Instead of roots they have root-like hold-fast organs, which fix the plant firmly to the rocky substratum below sea level. In *Nereocystis* the stalk or stipe has a bladder-like expansion or float which keeps the leaflike organs near the surface of the water.

The kelps have long been dried and burned, and formerly the ashes were the source of soda as used in glass-making and soap-making, now a source chiefly of iodine.

There are two species of living Sequoias, namely, the Coast Redwood and the California Big Tree. They are conifers related to the bald cypress of our southern swamps. The genus was named for Sequoyah, the Cherokee Indian, who invented the Cherokee alphabet, a fitting tribute to this native American.

The California Big Tree (*Sequoia gigantea*) grows native only in California, usually associated with sugar pine, Douglas fir, and incense cedar, forming extensive forests on the western slope of the Sierra Nevadas for a distance of about 260 miles north and south, growing at an altitude of 5000 to 8400 feet above the sea. Fine groves are preserved in Yosemite, Sequoia, and General Grant National Parks.



Reprinted from "Natuur en Techniek"

ONE OF THE WORLD'S GREATEST FLOWERS IN BLOOM

Amorphophallus Titanum, a giant of the far eastern tropics. Both in color and in odor it resembles decaying meat, while the odor of such a flower in a laboratory or a greenhouse is almost overpowering

Of the two species of Sequoia, the California Big Tree is the larger, but not the taller. In fact, it is frequently referred to as the largest (the most massive-stemmed) and oldest living thing in the world, and I know of no close competitor for this distinction.

The "Grizzly Giant" of the Mariposa Grove in Yosemite National Park is about 30 feet in diameter at the base, and 204 feet in height. It is estimated to be fully



ON THE STUMP OF A BIG TREE

Fifty-two men on the stump of a single *Sequoia gigantea*. This tree, a section of which is in the American Museum, was ninety feet in circumference at the level of the stump



THE BASE OF A CALIFORNIA GIANT

These huge trees, undoubtedly the largest of growing things, are now restricted to a few scattered groves, though formerly they were numerous over a large area. Dr. Clyde Fisher is seated in the foreground

Photograph by
Ruth Anna Fisher

A ROADWAY
THROUGH THE
WAWONA BIG TREE
This much-photo-
graphed arch is one of
the "sights" of Cali-
fornia

Photograph by Clyde Fisher



A FALLEN GIANT

This fallen Sequoia, in
Dennison Grove, Se-
quoia National Park,
shows clearly the last-
ing qualities of the
wood. Having lain
for many years on the
forest floor, it is still
remarkably sound.
Decay is extraordi-
narily slow, and for many
years still this great tree
will undoubtedly retain
its shape

*Photograph by
W. G. VanName*





Photograph by W. G. VanName

SUGAR PINES

This picture was taken on Big Oak Flat Road, Tuolumne County, California. These trees, while smaller than redwoods, are magnificent specimens in their own right

3800 years old. A road now used almost exclusively by automobiles passes through the base of the "Wawona" tree in this same grove.

The "General Sherman" Tree, which stands in the Sequoia National Park, is the largest of them all; the dimensions given by the Government bulletin are: diameter at base, 37.3 feet; diameter 100 feet above the ground, 18.7 feet; height 273.9 feet. "There is over a half-million board feet of lumber in the trunk; enough material to build 500 5-room houses."

In the Calaveras Grove there are three trees more than 300 feet high, the tallest measuring 325 feet. In the King's River forest, John Muir measured one having a trunk diameter, inside the bark, and four feet above the ground, of 35 feet, 8 inches. This tree is burned nearly half

way through, so that the number of annual rings could be rather closely determined, and these showed that the tree had lived not less than 4000 years, and Muir believed that there were trees still standing which are at least 5000 years old.

The bark of the California Big Tree is cinnamon-red in color and is from one to two feet thick on the large trees. The foliage of the two species of Sequoia is quite different. That of the Big Tree consists of sharp-pointed, scalelike leaves closely appressed to the twigs, resembling our familiar junipers. The foliage of the Coast Redwood is two-ranked, that is, feather-like in arrangement, resembling that of firs, spruces, hemlocks, and yews.

The California Big Tree has been planted in many parts of the world. The finest specimen that I have seen in the eastern part of our country is one on the



Photograph by W. G. VanName

MORE SUGAR PINES

The size of these trees can be visualized more clearly by comparing them with the man who is standing at the base of the tree on the left

shore of Lake Cayuga at Aurora, New York. It is a beautiful, symmetrical tree, about 50 feet in height, approximately 2 feet in diameter at the base, and probably 100 years old.

The specimen in the American Museum was obtained from the "Mark Twain" tree, which was cut in King's River Grove in 1891. In 1931, just forty years after the tree was cut, the stump was photographed by James A. G. Davey, as it stands still well preserved, just outside of General Grant National Park. The section of the trunk of this tree taken just above the one in this museum was sent to the British Museum of Natural History at South Kensington, where it is on exhibition.

The Coast Redwood (*Sequoia sempervirens*) ranges from southern Oregon to Monterey County, California. For the most part it is limited to the western slopes of the coast ranges, where it forms a narrow forest belt, rarely extending more than twenty or thirty miles from the coast, and rarely reaching 3000 feet altitude. While not so large as the California Big Tree, it grows taller and is more graceful at maturity. In height it ranges from 200 to 340 feet, being the tallest American tree, and possibly the tallest tree in the world. It would be interesting to know how it compares in height with a species of *Eucalyptus* of the Australian region, which has been claimed to be the tallest tree in the world, but the writer has no definite information at present. In size it is the second largest tree in America, being surpassed in size of trunk only by the California Big Tree.

"A tree that has lived 500 years," writes Ellsworth Huntington in his *Secret of the Big Trees*, "is still in its early youth; one that has rounded out a thousand summers and winters is only at full maturity; and old age, the three score and ten of the Sequoias, does not come for 17 or



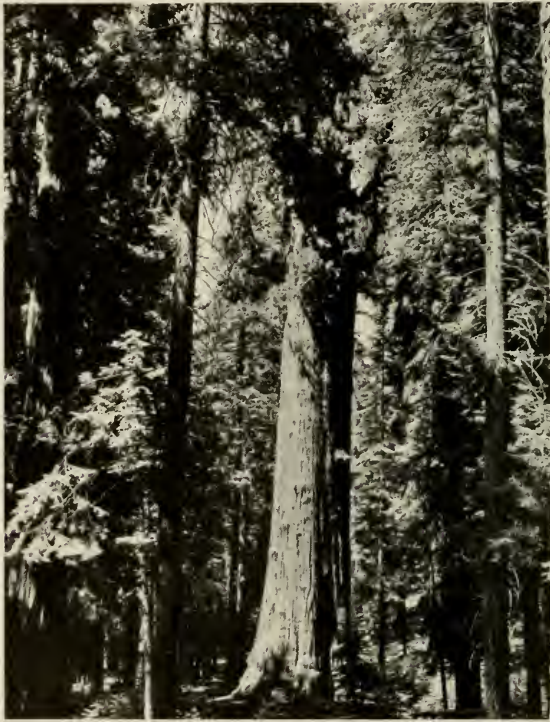
Photograph by Lindley Eddy
GENERAL SHERMAN—A *SEQUOIA GIGANTEA*

These big trees may live for 5000 years and perhaps longer if not destroyed by accident or disastrous climatic change. At present the General Sherman is probably more than 3500 years old

18 centuries. How old the oldest trees may be is not yet certain, but I have counted the rings of 79 that were over 2000 years of age, and 3 that were over 3000, and 1 that was 3150. In the days of the Trojan War and of the exodus of the Hebrews from Egypt this oldest tree was a sturdy sapling. . . . ”

Referring to the California Big Tree,

which he calls “nature’s forest masterpiece,” John Muir writes, “Poised in the fullness of strength and beauty, stern and solemn in mien, it glows with eager enthusiastic life to the tip of every leaf and branch and far-reaching root, calm as a granite dome, the first to feel the touch of the rosy beams of morning, the last to bid the sun good night.”



Photograph by Clyde Fisher, July 24, 1932

THE TRUNK OF THE GENERAL SHERMAN
CALIFORNIA BIG TREE

The largest and oldest living thing in the world. Discovered and named by James Wolverton in 1879



La Paz, Capital of Bolivia, with the Andes in the Background

ARCHÆOLOGICAL HIKES IN THE ANDES

An Introduction to Two of the Four Great Pre-Spanish Cultures

By WENDELL C. BENNETT

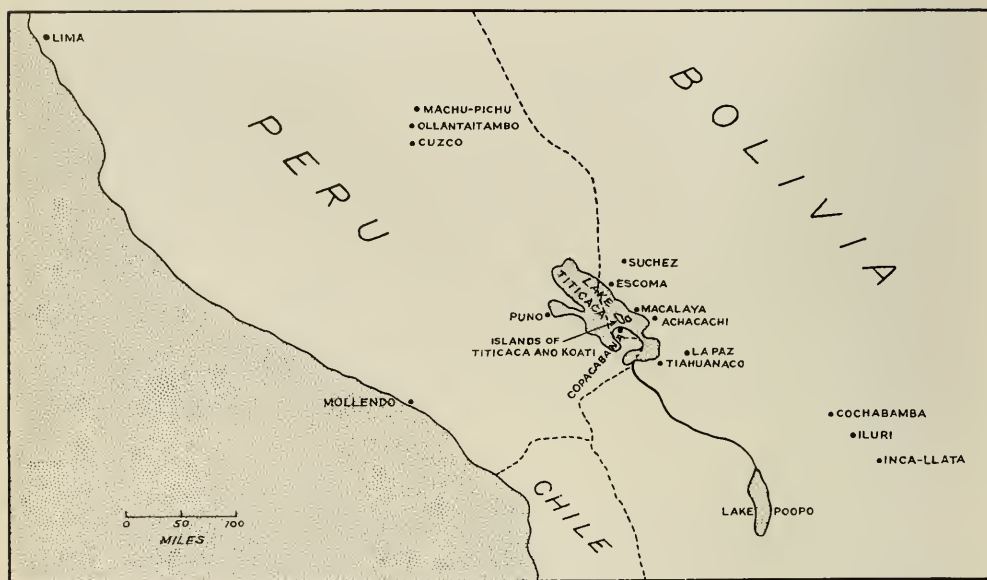
Assistant Curator in Anthropology, American Museum

CONSIDERED as a whole the archæology of Bolivia is a definite part of the Andean region which includes highland and coastal Peru, as well as parts of Chile and Ecuador. Of the four best known prehistoric Andean cultures, Nazca, Chimú, Tiahuanaco, and Inca, Bolivia holds the center of the Tiahuanaco culture as well as remnants of the Inca and traces of the Nazca. Thus its position in the pre-Spanish history of the Andes is extremely important.

Adolph Bandelier, noted American scholar and archæologist, was one of the first scientists to recognize the importance of Bolivian archæology. During the years 1897 to 1902 he made innumerable excursions to ruins on the alto plano, excavating, drawing plans, and carefully gathering material. These collections are now in the American Museum of Natural History. Their value lies in completeness rather than in uniqueness. Bandelier published one excellent study on the

Islands of Titicaca and Koati, as well as short articles on various localities in Bolivia. The mass of his material, however, has never been thoroughly described. Obviously first hand knowledge of the country is essential to the proper analysis of these excellent collections. Therefore, during the last year, Mr. John Phillips and I spent almost six months in Bolivia making a survey of the archæological possibilities, examining collections, and excavating on a small scale.

I should like to describe briefly some of the ruins which we visited in the southern highlands of Peru and Bolivia. For reference convenience, I have included the small sketch map which shows the sites mentioned. It is possible to do little more than give impressions of the different ruins, each one of which is a field of study in itself. The cultures represented by a ruin must be mentioned, since the account is one of a survey specifically



THE EXPEDITION'S ROUTE

Map of northwest Bolivia and southern Peru, including Lake Titicaca, which indicates the localities mentioned in this article

intended to trace their distributions. The three cultures generally encountered in Bolivia are:

Tiahuanaco—The oldest highland culture centered about the ruin of the same name near the southern end of Lake Titicaca. It was a highly advanced culture, distinguished by monolithic buildings and fine stone carving.

Inca—The culture centered about Cuzco, the ancient capital, which dominated all Peru and most of Bolivia, Chile, and Ecuador, at the time of the Spanish invasion.

Chullpa—An indeterminate classification including all material not definitely Tiahuanaco nor Inca, and especially post-Spanish material. Further study will undoubtedly give much stricter limitations and much greater significance to the Chullpa culture.

Against this brief background let us begin the hikes in the highlands.

From Mollendo, Peru, the ascent to the "alto plano" (high plateau) of Bolivia is a rapid one. With but a night's stop

in Arequipa the train chugs onward and upward. It is not until a pass more than 15,000 feet above sea level has been crossed that a slight descent is made to the plateau, itself 13,000 feet in altitude. In the rarefied atmosphere the nights are sharply cold. The body is enervated by the weakening effects of the "soroche," or mountain sickness. The landscape is barren, because no trees grow; and scarcely a bush breaks the monotony of the sharp-edged hills. A few straggling houses and a gathering of Indian peddlers announce stations along the railway, while herds of llamas, or occasionally the more timid alpaca and vicuñas, present the only sign of life on the purple hills. Was this the homeland of two of the greatest cultures of the Andean region? It was this question that Phillips and I discussed as the train droned along.

On the new steamboat, the "Inca," we crossed the icy waters of Lake Titicaca, and soon were riding again on the train from Guaqui to La Paz, capital of Bolivia. The first glimpse of La Paz

CHULLPA GRAVE

Upright slabs of stone forming ovals or rectangles which mark burial sites are commonly encountered in Bolivia

really gives a feeling of peace. Its glistening tin-roofed houses are pocketed securely in a valley, a thousand feet below the bleakness of the high plateau. A long glacial range cuts a jagged white skyline. Illimani, king of glacier peaks, guards the high-land capital.



We started out in an old Buick with an Italian chauffeur for the town of Achacachi at the southeast corner of Lake Titicaca. The Italian ran his car into a mud hole, so we went on by truck, surrounded by Indians. The extraordinary rise in the lake's level had made the roads impassable in places, so we advanced by mule-back. Eventually we set up camp in a bare adobe room at Macalaya and started scouring the hillside for ruins. On the first afternoon I discovered a small ruin with the fancy name of Tc!iliuput!-ungu, which consisted of several rooms built of crude mountain stone. Later, when we had found several really large

ruins, I received plenty of comments about my "sheep-pen."

The ruins which dot the low foothills overlooking the lake flats between Achacachi and Escoma are of Inca construction. Most of them were built as fortifications. Their situation is on naturally protected bluffs, and they are further protected by heavy walls made of parallel rows of big stones set on edge and filled with small stones and rubble. Within the enclosure are many houses built around rectangular courts. All openings and doorways face inward toward the court, and thus the blank outside walls of the stone houses serve as a secondary defence.

The houses are small, one-room affairs, made of carefully laid stone. The stones are selected and split, but not dressed. The doorways are narrow and much wider at the base than at the top. Within the houses are shelves, formed of flat stones built into the wall, and niches made by an



AN INCA HOUSE

The narrow doorway converging at the top is characteristic of these houses



FROM RESIDENCE TO
SHEEP PEN

Many of the stone houses on the ruins are still intact after more than four hundred years. They serve today as sheep corrals

the flats. To the west it commands the valley of Komoko.

It is probable that these forts were used only during times of strife. The lake flats served as farm land then as now. An isolated ruin like Himoko was probably the last

arrangement of stones in the walls, but no windows. The roofs are also of stone. The principle is quite simple. Flat stones are projected inward from the walls and weighted down by other stones. On top of these other stones project still farther inward, and are in turn weighted down behind. The process continues until the house is roofed. The result is a corbeled arch.

We ascended a peak called Monte Hipe, to visit the ruin "Himoko." Although plainly visible from the lake flats, the ruin remains almost hidden until you are right upon it. Then suddenly the vastness of the many houses, walls, terraces, and platforms is spread before you. The great ruin seems to be the key fortress to the series we were studying. It heads one branch of the valley of Sullulluni which contains about seven ruins. It stands above Macalaya and the four ruins along

stand. Its thousand small stone houses would have sheltered quite a population. Small lakes of fresh water were near it. Its heavy walls and the almost vertical bluffs made it practically impregnable.

This type of ruin is common along the eastern side of the lake. Farther north in the Suchez valley are many others, most of them containing stone towers. These towers are from one to two yards square at the base, and some are still from four to five yards high. The construction of these towers is generally the same. A shelf of flat stones extends across the interior of the tower about four feet from the ground level, thus forming a chamber



THE LARGEST HOUSE OF
THE MACALAYA RUINS

Sixteen feet long, twelve wide, and thirteen high, and once covered with a stone roof, without employing any great thickness in the walls

THE CORBELED ARCH OF INCA CONSTRUCTION

The roof of the house has fallen in but the first layer of flat stones that project inward from the walls can be seen



in the bottom section which is entered by a low doorway. The part above the shelf is left hollow in some towers, but in most of them it is filled in solidly with stones and dirt. These towers are found at most of the ruins. At first we thought of them as watch towers, the hollow interior, the shelf across the center, and the strategic location of some of them, all supporting this opinion. The towers of the last group of ruins were, however, clearly burial places. Skeletons were seen in almost every one. One ruin contained fifty-three towers, many of them grouped together in clusters of four or five. While the first use of towers may have been as lookouts, the sepulchre function certainly dominated at the end.

We now leave the high plateau and go down toward the interior of Bolivia. It is a long two-day train ride from La Paz to Cochabamba, where the height above

sea level is little more than 8000 feet. The sheltered valley supports trees and all sorts of semitropical greenery. Three types of ruins exist here. Near the pueblo of Pocona is a complex ruin of late Inca type called, characteristically, "Incallata" ("house of the Inca"). Large temples with high walls of stone reinforced with adobe, well built walls and houses with niches and open windows, elaborate fortification walls, irrigation ditches and "baths" for washing gold, all indicate the advanced Inca civilization, and perhaps the beginning of Spanish influence.

Iluri is another type of ruin. While foundations of ancient buildings can be traced with difficulty, the most interesting section of the site lies underground. A deep stream gorge indicates a disturbed depth of from ten to twelve feet, although this maximum is by no means uniform. Excavation reveals many stone



THE GATEWAY OF THE SUN

Tiahuanaco culture portrayed in a monolithic gateway of polished basalt, decorated with mythical running figures and sun gods



DETAIL OF CARVING ON
WAIST OF LARGE STATUE

The running figure of this design is almost identical with the row of figures on the Gateway of the Sun. The delicate design is in marked contrast to the massiveness of the statue

implements, axes, grindstones, polishers, bowls, and other types, as well as common pottery and some burials with longitudinally deformed skulls. Some of the finer stone work looks like Inca material. The pottery, however, is of the so-called Chullpa type and nowhere is there any suggestion of Tiahuanaco.

Tiahuanaco pottery is found in mounds near Cochabamba. These mounds, about thirty-five yards in diameter and two to three high, are artificial and contain burials as well as many potsherds. While the pottery has the conventionalized designs of pumas, condors, and humans, it compares with the decadent rather than the classical style of the real Tiahuanaco ruin.

Before we visit any more sites, the Tiahuanaco ruin must be seen. Really it should have been visited first, as it is the dominant note of Bolivia. The Tiahuanaco designs and drawings of

pumas and condors have had an extensive influence on modern Bolivia. Friezes of buildings, borders of programmes, decorations on medals, all incorporate the elements of the ancient art.

The Tiahuanaco ruin lies at the southern end of Lake Titicaca, three hours by train or truck from La Paz. The ruin is justly famed, not only for its gigantic dressed-stone masonry and distinctive art, but also as the center of a great culture which flourished in the highlands long before the Incas appeared on the scene. Only a brief description can be given here. Calasasaya, the sun temple, is a rectangular structure once outlined with walls built of upright blocks of lava and sandstone filled in between with smaller finished stones. Today little more than the uprights remain. Within the outer wall of monoliths is a smaller enclosure. At the



A BEARDED STATUE

Lying beside the large statue is this smaller one with hands outspread. Two pumas can be seen below the waist line. Note the contrast in style between this figure and the great statue beside it



THE GREAT STATUE OF TIAHUANACO

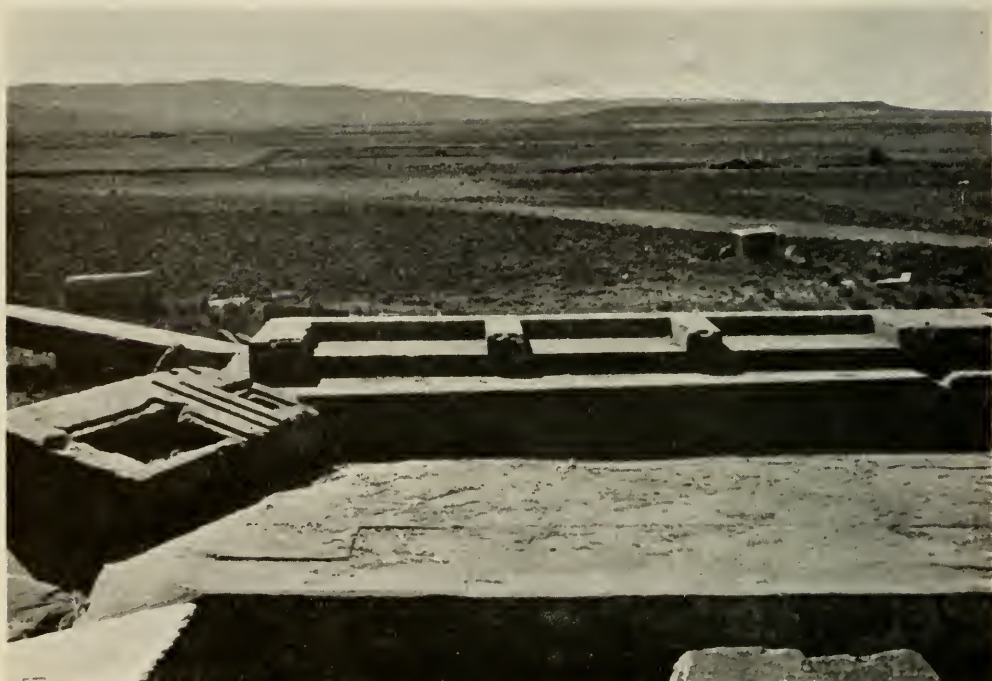
Twenty-four feet of carved stone as it was uncovered by the laborers. The medallions on the leg decoration probably represent cloth. The early historians were particularly impressed by this

eastern end of the temple is a massive stairway of sandstone blocks, flanked by two pillars. In the northwest corner of the temple is the famed "Gateway of the Sun," cut from a single block of lava and finely finished. The frieze carved on this gateway has been correctly described by Means (*Ancient Civilizations of the Andes*; p. 130) as the summation of classical Tiahuanaco art. The Viracocha god figure in the center, the stylized representations of pumas, condors, fish, caracols, and humans, all are characteristic of the art.

Another smaller temple lies to the West of Calasasaya, and to the south is the artificial fortified hill, once stone-faced, called "Akapana." Puma-Puncu lies at some distance to the southwest of the sun temple and consists of both lava and sandstone blocks, shaped and jointed for some building, the exact nature of which is unknown. The weight of some of the stones has been calculated at one hundred tons.

To the east of the sun temple (Calasasaya) is a small, square enclosure which

has been designated by Posnansky as the first period phase of Tiahuanaco. His excavations uncovered many stone heads of primitive Tiahuanaco style. Thus, when we obtained permission to dig ten test pits, each limited to ten square meters in area, this first period temple was one of the chosen places. The depth of the pit had reached little more than half a meter when a large stone was struck, which soon was identified as the head of an enormous monolithic statue. Thus our plans were modified sufficiently to uncover this new idol. It is of red sandstone and measures, from head to base, about twenty-four feet. The width and thickness average more than a yard, which indicates a weight of about eighteen tons. The size of this statue is unique, but the style of carving is typically Tiahuanaco. The head is wrapped with a wide band above which are grooves representing plumes. The face is stylized. Three tears stream down the cheeks from the eyes. Both hands are on the chest. A



TEMPLE OF THE MOON, PUMA PUNCU

One of the units of the Tiahuanaco ruin is this temple of carefully carved blocks. The stone in the foreground weighs one hundred tons and was fitted and joined to the other blocks by means of copper keys and clamps



COURSED MASONRY OF CUZCO

When the plaster is scraped off a wall in Cuzco, ancient Inca capital, a beautiful stone backing is commonly revealed. Above this wall the plaster can still be seen

cup is held in the left hand, while the right grasps some unidentifiable object. Delicate running figures, closely resembling those on the Gateway of the Sun, are cut on the chest and waist. There is a wide carved waistband, and below it a polka-dot design probably designates some form of cloth pants. Five-toed feet rest on a stalwart base. Were the statue erect, it would stand approximately in the center of the small temple. Furthermore, were one to stand in the center of the sun temple (Calasasaya) and look toward the East across the monolithic stairway, he would see the erected statue in the very center of the stairway, cutting its outline against the sky above the low hills on the horizon. Since the center of the stairway has been calculated as the setting point of the sun during the equinoxes, the position of the statue gives it a real importance.

It is unjust to leave Tiahuanaco with so brief a description, but time is pressing. The Islands of Titicaca and Koati are the next stop on our itinerary. These small islands are famous in the mythology of the Incas as the origin of that great culture.

A chugging ride in a gasoline launch across the peaceful waters of Lake Titicaca brought us by moonlight to the Island of the Sun (Titicaca). With Bandelier's admirable map in hand we visited most of the sites recorded by him during his long stay on this beautiful island. Most of the ruins are of Inca and Chullpa types, though some well dressed stones suggest a previous Tiahuanaco influence. We wandered down a stone-paved trail of the Incas to visit the cat-shaped rock hill called Titikala. The ruin of Chincana, near by, proved a complexity of walls, covered passages, and doorways.

A short ride brought us to the Island of the Moon (Koati). The one large



"THE GALLOWS" NEAR COPACABANA

Cut stones form a platform between two natural monoliths high above the pueblo of Copacabana. The appearance suggested the modern designation of gallows.



THE FORTRESS OF SACSABUAMAN

This is the lowest of three terraces which form the basic structure of the fortress. The handling and careful fitting of stones weighing many tons is one of the wonders of the world



A DOORWAY AT MACHU
PICHU

This classical example of fine Inca masonry is found at the ruin at Machu Picchu. The doorway converges at the top in characteristic fashion

temple consists of rooms built around three sides of a court which overlooks the lake. Elaborate doorways, and stepped-niches are still partly covered with the mud-plaster and paint which once made a gaudy spectacle.

Once again at the Sun Island, we visited the Inca fountain, erroneously claimed to spurt salt water from two of its three spouts. Then to the ruin of Pirco-caima, very similar to the temple on the Moon Island. It has small, square rooms in which the corbeled arch has been utilized for a dome.

We continued in the launch to the peninsula of Copacabana, famed for its Virgin and the 6th of August fiesta. There we visited a site called a tribunal of the Incas, which consisted of many stone seats cut out of solid rock. Appropriately enough we found the "gallows" high on a hill behind the town. Here two natural upright rocks about four feet apart have had notches cut out at 14 feet above the ground and dressed stones placed between in the form of a slightly convex platform.

As our journey continues we must leave Bolivia and enter Peru, though continuing on the plateau. It is impossible to sum up the complexity of Cuzco and the nearby ruins of Machu Picchu and Ollantaytambo. However, this region has been

more thoroughly described by travelers and scientists than the parts of Bolivia already visited, and so the inadequacy of my account here can be easily supplemented by the interested reader.

Cuzco is one of the most picturesque of the

highland towns. Colonial architecture has been superimposed on the old Inca capital. Where the plaster has fallen away, the stalwart Inca walls, or well-cut Inca gateways are still to be seen in the streets of Cuzco. Indians with herds of llamas still pack the narrow streets as their ancestors did before them. Inca walls are of three types in Cuzco. There



ROUNDED CORNER ON SECOND TERRACE
OF SACSABUAMAN FORTRESS

The terraces are laid out in saw-tooth plan for better defense. This is one of the corners. Note the intricate fitting of the blocks

AT THE RUIN OF
OLLANTAITAMBO

A long, niched wall, on a terrace at this famous ruin. The niches, the masonry, the gateway at the end are all typically Incan

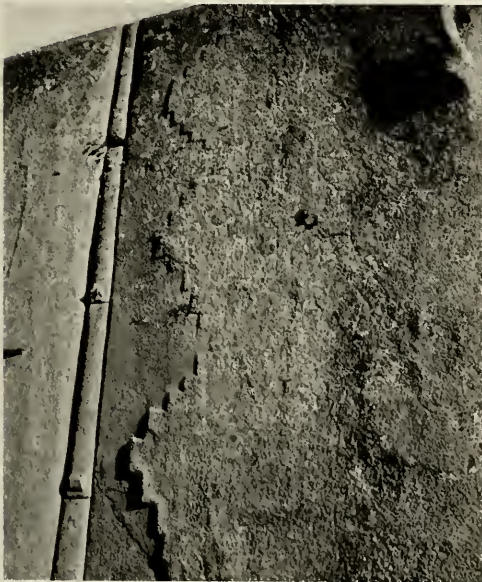
is a wall of dressed rectangular stones, carefully laid in horizontal rows, with a smooth finished appearance. A somewhat similar type is composed of small blocks also laid in horizontal rows. The blocks are rounded on the front side and thus do not give that smooth effect. The third type is the polygonal, in which stones of different shapes and sizes are ingeniously cut and matched into a crackless wall. This is the type of wall utilized in the fortress above Cuzco, called Sacsahuaman. Tremendous stones are employed. Rectangular, curved, triangular, and wedge-shaped joints are seen. Each



stone must have been brought to the wall and then cut and fitted, as no plan could possibly have been made in advance for so irregular a structure.

A remodeled Ford on flanged wheels skids rapidly down the track from Cuzco to Machu Pichu (the site made famous by Hiram Bingham). From the end of the railroad track a foot trail leads almost straight upward for an endless distance to the ruin. The heat is stifling; the heart pounds mercilessly in the high altitude; the mind pays tribute to the Incas that built a city on top of such a hill. The buildings of fine coursed masonry, the cut stone seats, the terraces and steps all represent the finest of the Inca work. The ruin is extensive. Across the deep valley can be seen a peak rising high above Machu Pichu. No trail remains to the summit of that point. Our guide cheerfully informs us that some ruins were there, too.

Back toward Cuzco on the same railway line from Machu Pichu is the ruin of Ollantaitambo. Three types of building are represented, as well as cut stone seats, baths, and fountains. The commonest building is of stone, faced and filled with adobe, and covered with yellow paint on the outside. The fine construction work of the Machu Pichu type is also found in



DETAIL OF A MONOLITHIC WALL AT
OLLANTAITAMBO

Six large slabs form a wall on one of the upper terraces and probably represent a period contemporaneous with Tiahuanaco.

walls, niches, and doorways. Finally there is one excellent wall, and various individual blocks of sandstone, well cut, finished, and fitted. The treatment of this stone certainly suggests Tiahuanaco influence, and the double step design carved on one of the wall slabs augments this idea.

In this sketchy account of hikes in the Andes, six months' work is recorded in a few pages. Some of the details and the problems are suggested, though obviously little more can be done in so short a space. The first great problem in the

highlands is the analysis and description of Tiahuanaco culture. Then, the distribution of this same culture and its relation to other cultures, not only in the highlands but also on the coast of Peru, is of paramount importance in a historical study. There is some evidence that Tiahuanaco influence spread far. Carving of Tiahuanaco style has been found in northern Peru, at Chavín de Huántar, and as far north as Ecuador. The exact determination of the relationships is a matter for considerable study. So, for the time, we will return to sea level and resume work.



CARVED STONE HEAD FROM TIAHUANACO
Found near the great monolith but representing
a completely different style of workmanship,
thought by many to be the earliest Tiahuanaco
art



A Grassy Valley in the Heart of Asia

THE ILLIK OF THE THIAN SHAN

Collecting Roe Deer for an American Museum Group on the Grassy Slopes above Timber-line of the Mountains of Central Asia

By JAMES L. CLARK

Vice-Director (In Charge of Preparation and Exhibition) American Museum

OF all the glorious hunts I have had during my thirty years of collecting, the quest of the illik, or roe deer, stands out as one of the best. It was perhaps the one high spot of the whole Morden-Clark Expedition across Asia.

After weeks in the cold and barren Russian Pamirs after *Ovis poli*, and then a six weeks' trek over hot and dusty deserts of Central Chinese Turkestan, we suddenly entered a land which was glorious beyond words. It might have been made so by the sharp contrast, but even now, as I look back, mentally retracing my steps while fully rested and not dog-tired and thirsty, it still lingers as the most glorious spot I have ever known.

We had trekked those sandy, scorching plains for days upon days, through a land somber, monotonous, and uninhabited, except for an occasional village or even less—a serai by a man-made well many feet deep, where little, and often

muddy, alkali water, hardly fit to use, was sparingly doled out to tired and thirsty men and beasts.

From this arid land we followed a great gorge into the heart of the Thian Shan, where water from high glaciers and steep cañons was so full of silt that it was little better, and was bad for cooking and even worse for drinking. The cañons, too, were barren and uninviting, bleak, rocky walls, often spotted with great areas of pure white marble, so steep that no bush could cling to their sides long enough to grow to any size, and below, a mass of rugged boulders were strewn hither and thither over a narrow cañon floor where swift and tortured icy streams dashed their thundering way from side to side, to find a course to lower lands.

At the head of this narrowing valley a great and massive glacier choked its very end, dumping its débris in huge piles of oozing mud and rock before its melting snout. This blocked us for the day, and



A NEW LAND

After a six weeks' trek over the hot deserts of Central Chinese Turkestan, the Morden-Clark Expedition suddenly came upon this glorious scene

cold, tired, and wet from an all day's trek in the rain, we camped among towering boulders as shelter from the chilling winds. The following bleak morning was a bad omen for our day's march, which was to be over the surface of the glacier, for this was the way of our trail from Yarkand to Siberia. A day of toil over a sea of ice and more rain, until after many hours of slippery ascent, with sliding and falling pack animals, we left the glacier, which made a sharp turn to the right, and again trod on solid ground that led us to a pass beyond, carpeted with grass and heather.

Before us lay a promised land. What a change from desolation to a land of plenty!

From our 11,000-foot pass we gazed down grassy valleys into wooded lands of bounding streams. Great forests of deep blue spruce spotted hillsides of emerald green, while snow-peaked mountains crowned it all.

Hardly could we believe our eyes! What a joy to our tired and parched

brains, which had for so long been seeing and thinking nothing but brown dust and rocky wastes.

We dropped steeply down a carpet of soft, velvet green, sprinkled with forget-me-nots, yellow and blue pansies, iris, and many other wild flowers, into the bottom of it all, and were finally hemmed in as we wound along narrow streams and came to a camping spot, as night closed upon us. Daylight came after a long night of sound sleep, and in the sunshine of the morning we gazed up from below again to our fairyland of green.

Here was the home of the illik, and above it, high on the precipitous rocky ledges, the big ibex lived out their lives, coming down from their lofty crags at early morn and late evening to feed on the grassy slopes below. It was hard to believe that such a transition of countries could be separated by only a ridge, but this ridge was high (generally 20,000 feet) and the cool winds from the North precipitated all their moisture as they struck

this high wall and dropped an abundance of water to irrigate bountifully this fertile land, while not a speck of it got over the other side into the great basin of Chinese Turkestan. And the Himalayas, an even higher range, even more effectively walled out the moistened winds of the South, causing them to drop their waters over the tropical forests of northern India, while Central Asia lay dry and barren.

Everyone rejoiced in our new camp. Firewood and clear water aplenty made our own life again comfortable, while our worn and hungry pack animals fed and rolled in fields of luscious grass.

Three days were spent in rest and reorganizing, getting fit, repairing and repacking equipment, while we drank of the joys of scenery unsurpassed and basked in the warm but tempered sunshine.

At evening we would watch the ibex as they cautiously started to descend, while from the depths of the forest the "bark"

of the illik resounded across the valley, and wild pigeons in wavering flocks flew to roost on the lower walls of rock.

We were anxious to get after our illik. We wanted a group for the new North Asiatic Hall at the American Museum, but deferred with restraint until we could make a day of it.

Below us in the valley were a few scattered Torguts, a people of almost pure Mongolian blood, living far to the west of the Gobi.

Here they wintered with their stock of horses, sheep, and goats, living in their own comfortable yurts, made of thick felt. Children, cute, but unbathed, played about the low doorways.

Staked to the ground was a golden eagle, which they use as a falcon, both as a sport and to catch small game for food.

The men are great hunters and at the proper season go into the mountains for days to catch the fur-bearing animals



TORGUT GUIDES

The Torguts are a people of almost pure Mongolian blood, and these two, mounted on their bullocks, served Mr. Morden and Mr. Clark as guides in the roe deer country



CROSSING A GLACIER

The expedition camped in a glacier-filled pass among towering boulders which served to protect them from the cold wind

softly tapered from the solid white into greenish slopes below. The air was now crisp and clear. We left camp, passing over our meadow flats, and dropped off a steep bank to cross a tumbling river to the flats of the other side, where we turned to follow it downstream.

which they send north to Russia. At this time they were out for illik, for every one they can get for meat saves another sheep of their own flock.

These Torgut hunters we recruited as guides, and through our interpreters, had much pow-wow as we discussed all the possibilities. Finally, all was set, with plans for the morrow.

As daylight broke, we were in our saddles, ready to start, led by our two Torgut guides perched high on their bullocks and carrying their old matchlock rifles with long, forked sticks at the end. It was not that they should shoot if we failed, nor that they needed these weapons, but they are a symbol of distinction to them, and to us—well, it just made them more picturesque, even if they did occasionally catch in the bush.

A cold, drizzling rain had fallen in the night and a fresh mantle of snow lay high on the mountain tops, which

Daylight came swiftly, and the sun soon struck the peaks of newly fallen snow, bathing them in a soft pink against the clear blue of the morning sky. A cold, blue haze lay stratified in the lower levels of the valley and modeled the contours of distant ridges in sharp relief, grading up into the deep blue-green of spruce to outline them in sturdy silhouette. It was a setting typical of our Rockies, and brought back pleasant memories of many mornings when I had likewise started out to hunt our elk.

My eyes were searching the open of the hillsides for little red spots, for now the illik would be coming into the open to



A TORGUT FAMILY

These natives were camped in the roe deer country, and lived in yurts made of felt stretched over a wooden frame

THE ILLIK, OR ROE DEER
This little animal, collected by the expedition for the American Museum, is a beautiful creature with exceptionally graceful antlers



feed. Up and up we climbed over rugged ground and through deep bush and big timber, to get to the higher grassy slopes, where our chances would be better. Occasional barks would greet our ears and lead us on, while now and then a loud one would startle us as from some near-by thicket an unseen illik bounded away.

At last it became too steep to ride, and as chances were getting brighter, we left our horses with one Torgut and proceeded on foot. As we gained in elevation we came on to open slopes of a luxuriant growth of coarse grass and wild flowers, most of which stood about fifteen inches high. The drizzle of the night before had built up a coating of ice over every delicate leaf and flower, until all was encased.

In effect it was a hillside of glacé plants in their entirety, their colors showing through the clear ice in all their brilliance.

As the morning sun crept down the hill-sides and brought this under scintillating rays, they sparkled like jewels, which added even more gorgeousness to our already resplendent setting. We stood in amazement at it all, awed by the sight, almost forgetting that we had come to hunt the illik.

We hesitated to tread upon such a lovely spectacle, but glorious as it was, this ice made climbing difficult and dangerous. We were down on all fours as often as we were upright. But it did not last for long, as warm beams of sunshine soon cleared it all. We were now up in the favorite haunts of the illik, the grassy slopes above timber, where we might expect to see them any time.

As we rounded a hillside, we saw reddish streaks dart up the slope and out of sight, only to appear again higher up in the snow and over a ridge.

This was our first glimpse of our quarry.

TURKIS

Happy in the pleasant surroundings of a new camp, these young men were for a time a part of the expedition's personnel





A LAND OF BEAUTY

This central Asian valley with its snow-capped mountains, tree-clad slopes, and flower-dotted meadows is similar to the valleys of the Rockies. Here firewood and water were plentiful

It was incredible how fast the little things went up these steep slopes. Now that we had seen them, we knew just what to look for, but it was obvious we had to be most cautious.

Now, the little "illik," which is the native name for this roe deer, is a beautiful little creature. He's just the same as the roebuck of Europe and, in fact, continues right across Asia, clear through to China, where he is slightly larger. Standing about thirty inches in the shoulders and weighing seventy-five to one hundred pounds, he has all the deer characteristics in contour and habits.

His face is inclined to be short and chunky, but the most peculiar thing about him is that he has no tail. There's not even a bump where the tail ought to be, although under the skin there is a little stump, where the tiny tail bones lie hidden. No other deer or antelope that I know of has so completely lost his tail.

When curious, he has a decided "bark," which is rather throaty, like the bark of the African bushbok and leopard, which one hears just before dusk when they start out to feed. When frightened, he

gives a sharp whistle, which at close range always startles you, even though you may be expecting it.

His horns, which measure from fifteen to twenty inches in the Asiatic variety, run much less in the European cousin. They carry usually but two prongs, and it is characteristic of them to be well-beaded, while they run rather vertically



A TRAIL ACROSS A GLACIER

Separated from the outside world by glaciers and arid, rocky valleys, as well as by the great mountains of the Thian Shan, the roe deer country is rarely visited by white men

from the head with little curve and only a slight spread.

We continued our climb to a sharp, rocky ridge, and cautiously looked over into the next draw, which seemed a likely place. When we came to the top, no deer could be seen. At the bottom of the draw the big woods tapered off into bush and this, in turn, ran up into the grass slopes above us. For some minutes we carefully looked about and then someone called and pointed uphill. There, to our surprise, were little red spots scattering up the valley.

We could not see horns, and did not have time to use our glasses, but Morden, with a well directed long shot, stopped one. Our Torgut went up and rolled

it down, for the hill was too steep for packing. It was a fine specimen of a female and in good heavy coat. We took careful measurements and notes and saved the entire skin and skeleton.

Our short experience up to this time was enough to tell us it was not practical to hunt together. The country was steep and rough, and to keep that necessary contact with each other which good hunting demands, was difficult, so we decided to separate and hunt by ourselves, each with a guide.

The morning passed without further success, although I did see on distant slopes, here and there, an illik or two. From one lookout point I saw a doe, fol-

After the sun was well up, no more illik could be seen. At this late hour they were going to cover, to lie up for the day, and would not appear again until their next feeding time, in late afternoon.

We did, however, maneuver around a bit to get the lay of the land to see where likely places might be worth watching for the late afternoon hunting.

As the sun ascended to the zenith and beat down from a clear sky, it became very warm. We began to get tired, so we decided to lie up for a noonday rest.

After a bit of lunch we lay out on the hillside and had a sound sleep, which refreshed us all, while our animals, tethered to the near-by bushes, grazed the grass within their limit clear to the ground. About 2:30 we again began to move slowly along the hillside, where better grounds appeared more often. The contour was such that from any one place we could see only a limited area, too small to wait out the day on the chance that an illik might come in that particular spot. So we decided to keep moving, but to advance with caution.



A CAMP IN THE WOODS

Surrounded by trees, beyond which lay the grassy slopes over which the snow-covered peaks stood sentinel, few more beautiful spots could be found in all the world

lowed by two fawns, come out of a patch of big timber into a little, grassy spot.

She was so far away, and the approach was up such a steep, rough bank that I knew my chances of getting her were very doubtful, so I watched them until they passed into cover again, which was not long after they appeared. Had I started the stalk, I would never have reached her in time, as I had suspected.



RESTING AFTER A HUNT

Pleasant places in which to camp were easy to find, and clear, cold streams made life in the open more than usually comfortable and delightful for the expedition



A NATIVE CARAVAN OF DONKEYS

These heavily laden animals have been outspanned to rest after a long pull over the plains. The Morden-Clark Expedition frequently passed such caravans on the trade routes of Central Asia

Many times we stopped short to bring our glasses into play on a red spot on the hillside, only to find, after a long time of waiting for it to move, that it was a rock.

Now, these little illik are not protectively colored. On the contrary, they are most conspicuous, as their sienna red coat makes them the one outstanding spot on the slopes of green. But nature has otherwise protected them by mimicry, for she has painted scattered boulders with a lichen of exactly the same sienna color to fool their enemy: and often we have been intent on watching a red rock, only to find our illik bounding away while we were preoccupied in trying to make an illik out of a red stone.

Some will say that this theory of protection by nature is a bit far-fetched. I'll admit it is, but we found it working and at least it did have results, for it saved more than one illik from our guns, and it

must likewise save some from predators which prey upon them.

Later, as we were clinging to a steep hillside, making our way along as best we could, and hunting at the same time, we were startled by a very shrill whistle, followed by two quick snorts. It was but a few yards above us, over the crest of the hill. We knew it was an illik, and dared not move. Whether it had seen us, heard us, or scented us, we did not know, but we stood motionless.

This was the closest we had yet been to one, and if we could only get a glimpse of it, it might be ours. Again a whistle, and a snort, right from the same spot. We now felt sure it was suspicious, probably having heard us, so very cautiously I started in the direction of the sound. But as the ground levelled off, the grass became very thick and was well up to my shoulders.

My gun was ready, and I was intent on

the bush ahead when all of a sudden a shrill whistle nearly took me out of my skin, and a red streak passed me close by, going down hill in great bounds, topping the long grass with each leap. I made a quick step forward for position, when evidently my toe caught under a root, and over I went, head first, somehow to roll up on my feet again, gun in hand, as quickly as I went down, and all to the great surprise of myself and the guide, who in spite of his efforts to restrain himself, simply roared at my ungraceful antics and looked surprised, while my illik bounded away in perfect safety, as I stood dumbfounded at what had happened.

Here, my guide told me in sign language, was a likely spot. But for the time being, I was more interested in its beauty. Above me was just another of those bits of nature in this lovely valley that came upon one as a great surprise.

As we topped the bank from which our

illik sprang, we gazed up a large, open draw, which was a mass of lovely pink. Great spruce flanked the upper end and tapered off along the sides, while here and there stood the sturdy silver-gray and blackened stumps of mighty trees, which had once been green until some forest fire had licked them to their very tops. And now, as if to mock that long past fire, the fireweed made a blazing carpet on the floor.

How often I had beheld a similar scene in our own Canadian Rockies. The blue sky, the deep-green spruce, the burnt timber, the fireweed—yes, an old grizzly or a bull moose might well step out of this very scene almost anywhere.

I drank it all in to my heart's content, until my guide bade me go on. I told him to lead, and he took me up to the leeward side overlooking the draw and motioned me down. Now, he said, again in sign language, if we sit still, we might



TWO ILLIK FAWNS

These graceful, gentle little animals, brought into camp by the natives, were for days the pampered pets of the expedition

see illik and especially the spotted fawns, which I was so anxious to get for our group. Here the mothers hide them, he told me, and then he took a wide blade of grass and placed it between his thumbs and putting them to his mouth, blew a squeaking note, like the bleat of a very young fawn. This was the way they hunted them, he said. This imitated the sound of the fawn, and if any illik were around, they would come to the call.

And, sure enough, on the second bleat there suddenly appeared, on the opposite slope in our garden of pink fireweed, an illik doe. She must have been lying down, for all of a sudden there she was, with neck stretched high and ears erect.

She was about 150 yards away, and within a few minutes she was within 25 yards of us. Cautiously she had advanced to this call, while we sat only partly hidden from view. As Morden had already secured a doe and as this one had so faithfully answered the call of her kind, I just watched her and, after many observations which gave me excellent study for the mounting of our specimen, I left her in her garden spot and quietly walked away.

Time was passing and the sun was getting low. We had spent more time playing with this doe than I had realized; it was worth it, but now we must get on. I was particularly hopeful of getting a buck, but so far had not seen one.

Again we came to a ridge and, as before,

I suspected that the valley on the other side would be a likely place.

I left my Torgut below and climbed to the edge, but nothing was in sight. Carefully I watched from my vantage point, unseen, and there, across the draw on the steep side, was a movement of red.

Quickly I got my glasses on it, and saw a fine pair of horns. It was a very good buck, in good coat; then it disappeared. I knew it had not seen me and had not moved off, for I could have caught glimpses of it as it moved. There was no time to shoot. It was but a glance. There was my buck. Now, if luck would be with me, I might get him.

I slipped back until I just peeked over the rocky ledge and watched and watched, but not a sign of him. For more than an

hour I watched that spot, always wondering if he had beaten me and made off, or if he was still there. Somehow I felt confident. I felt that when I had seen him, he had gotten up to stretch and had lain down again, but of course I could not be sure.

It was well past the time when he should be moving, and the sun was already getting low. All this was a good indication, for the older and bigger the buck, the wiser he

is, and this kind al-

ways lingers and comes out late, long after the does and young bucks appear. I dared not take my eyes from the spot, and already I was feeling the strain of concentration and searching with the



CHILDREN OF THE ILLIK COUNTRY
Shy, unbathed youngsters played about the low doorways of almost every native yurt



A NATIVE CAMP

In this valley the natives winter with their horses, sheep, and goats

glasses. Time was now drawing to the end. Before very long it would be too dark.

In a moment of relaxation my Torgut grabbed my arm, and I gave a start, knowing what it meant. There was the red spot again, and I got my glasses. He was up on his feet and stretching, yet still partly sheltered in the thicket. Only because he was on the opposite bank could I see him at all. I was looking into the bushes, which were well over his head.

The bank was very steep, almost a wall—and I knew it was useless to attempt a stalk. I could not have seen him at fifteen feet on that slope, so there was but one thing to do—stay where I was and take a long shot.

I carefully judged the distance at 150 yards, and waited. Through my glasses I got the position of his body back in the bush, but I could see only his head and neck with my naked eye.

Now I was ready, and took careful aim, knowing I should have but one shot.

With a good rest, I waited until he was still, and then fired. I saw him slump and drop out of sight. I felt confident he was down for good, but I took no chances. Staying in my position, prepared to fire, I sent my guide down through the bush, while I marked the spot and stood ready. The spot was difficult for the Torgut to find, but I directed him to it; there was no sign of the deer. While I watched, he carefully searched the bush within a radius of many feet.

My heart sank in despair. I told him to stand still so as to mark the spot, while I came over. Then both of us searched the bush for a solid half hour on hands and knees in our last effort. There was not a sign of blood and at times it was so steep we had to hold on to keep from sliding downhill. We felt we must give it up, when I saw a spot that looked as though something had been dragged over the ground. I followed it along under the bushes until there was a drop of some

eight feet that was completely hidden by the thicket, and looking down, I saw my illik there under a clump of ground pine. He had just slid to complete oblivion. How lucky to have found him just before giving up!

While I dragged him down hill, over rough ground and through tangle, my native went for my horse and his bullock. And while we were loading the animal across the saddle, I again thought how exactly alike was this country to our golden West—a deer, the big spruce, the fallen trees, the carpet of brown needles, even the rocks, the little trickles of water bordered by their rounded tufts of velvet-like moss, the blue jays that flew above

hoping for scraps of meat, and the crisp evening air, now getting chilly in the shaded depths of the forest.

As we broke out of the deep forest and turned a sharp ridge, the whole valley again lay before us. Far away at the upper end, from a point of woods, a little gray column of smoke rising vertically and spreading mushroom-like in the quiet evening air told us where our camp was.

As we rode, tired but content, downhill and homeward bound, with the sinking sun now just tipping the uppermost peaks on the opposite side of the sylvan vale, I could not help but reflect that I had had one of the most wonderful day's hunts that I have ever known.



A Central Asia Scene That Might Almost Be Among the Alberta Rockies



Even on the Flat Plains, Motor Travel in Patagonia Is Beset by Constant Difficulties

A DAY IN PATAGONIA

Collecting Remains of Prehistoric Animals in Southernmost
South America

By GEORGE GAYLORD SIMPSON

Associate Curator of Vertebrate Paleontology, American Museum

HA salido el solcito, señor doctor! "The sun is up!" cries Balaña outside my tent.

"Let it go back again!" I reply. It is our daily joke.

I roll sleepily out of my fur blanket, made of young guanaco skins sewed together with ostrich sinews, shiveringly pull on some clothes and a pair of canvas slippers with soles of coiled rope (*alpargatas*), and go outside. It is a typical Patagonian summer morning, the cold wind just getting up to its full fury after a temporary lull before dawn, the red sun creeping over the far rim of Cañadón Vaca.

The third base camp of the Searratt Patagonian Expedition has an unusually good location for this forlorn part of the world. It is in a little hollow in the side of a great valley, or cañadón. To windward is a clump of thorn bushes, taller than a man and as high as any native vegetation for hundreds of miles in any direction, and to leeward is a spring of clear but slightly alkaline water. Balaña, the cook, has cleaned out the spring, and the discovery of prehistoric Indian implements in it showed that this has

long been a favored camp site. Balaña has also amused himself by making a series of ponds along the thin trickle of water, in the few yards before it seeps into the ground and disappears. He says that the main spring is for us, the first pool for small birds and mammals, the next for ostriches (*rheas*), and the last for guanacos—for water must be shared by all living creatures in this almost waterless land. The guanacos are very punctilious in using their proper pool, possibly because it is the farthest from our tents, but the other creatures are not, to Balaña's mock annoyance. A suggestion that he put up signs for them is not well received, for Balaña and the beasts are about on par in ability to read and write.

This camp site is so much appreciated that it has recently been used by a band of Chilean robbers. Finding pickings too thin on their own side of the Cordillera, they crossed the mountains and wandered into Argentine Patagonia, finally settling down here, where they eked out a miserable existence for several months. When they could, they killed



LA OFICINA DEL DIABLO

The "Devil's Office" is a tremendous amphitheater cut by wind and rain in thick beds of white and pale colored volcanic ash. In it the expedition found many specimens of the oldest mammals of South America, buried forty or fifty million years ago

This morning as I come out of my tent several guanacos are drinking at their proper place. The leader, perched on a hummock near by, spies me and whinnies, setting his flock to ambling away over the cañadón rim. At the cook tent Balaña has warm water ready for washing, a luxury which he considers very effete but on which I insist. Maté is ready and I drink it as the cook prepares breakfast.

Maté is the drink of the masses not only in Patagonia but through-

sheep from neighboring flocks, and when these were too well guarded, they caught guanacos with bolas or went hungry. The number of guanaco bones in their débris reveals the low estate to which they had fallen, for even the poorest Patagonians scorn to eat this stringy and ill-flavored meat. The neighbors did not appreciate the depredations of the Chileans on the flocks and finally reinforced an invitation to leave by appearing armed and *en masse*. The outcasts departed, but left a malodorous memory so that, when word got around that another party had settled at the spring, apprehensive sheep herders cautiously scouted out our camp and had to be persuaded that we are harmless and that we will even go so far as to pay cash for sheep to eat.

out the Argentine, Uruguay, Paraguay, much of Brazil, and some adjacent regions. It is made from the leaves of a tree, *Ilex paraguayensis*, a relative of the holly, which grows chiefly in Paraguay, where the most highly prized leaves are found, in Northern Argentina, and in southwestern Brazil. The leaves are gathered, heated thoroughly until dry and brittle, then ground to a convenient fineness. The drink is prepared in various ways, but the really native way is to place the ground leaves, yerba, in a gourd, then to pour in hot water. It requires no time to brew and the infusion is at once drawn out through a metal tube, the bombilla. Then more water is poured in, and the process repeated until the yerba has lost its potency, which is only after ten or fifteen infusions with good

yerba, or until the user is satisfied. The latter contingency rarely arises among the natives, for they often drink maté all day long, hardly stopping to eat. Baliña, for instance, solemnly asserts that he has drunk no water for fifteen years, maté supplying all his liquid requirements.

Although it has never been successfully popularized outside of its native area, maté is used by literally millions of people every day and ranks with tea or coffee as one of the leading non-alcoholic beverages of the world. Its taste is distinctive, but remotely suggests that of tea, and it contains a stimulant, *matteïn*, which is similar in properties to *thein* or *caffein*. Unlike tea or coffee it is also very mildly cathartic and it seems to be a valuable supplementary element in diet, for many people in South America never have vegetables,

living on nothing but meat and maté, yet remain in perfect health. Having perforce to adopt the heavily carnivorous regimen of Patagonia, we also adopted maté drinking. The bitter taste is not pleasant at first, but becomes very agreeable with practice. Many Europeans in South America, particularly those who have an abiding fear of "going native" scorn the drink, and those affected South Americans who attempt to appear "Europeanized" also profess to dislike it, but it is dear to the heart of the people and its preparation and sale is one of the major industries of the region. Its detractors insist that its popularity is chiefly due to the fact that a native drinking maté feels no necessity to work or to think.

I drink maté, then, while Baliña cooks, and entertains me. He is an inexhaustable source of information, most of which



LUNCH

For lunch in the field the members of the party sought caves and crevices for shelter from the eternal wind. On the left is Justino Hernandez, ablest of the native assistants. The man on the right is drinking maté



THIRD BASE CAMP OF THE EXPEDITION
Baliña and Williams in front of the cook tent of
the camp in Cañadón Vaca, where the Searritt
Expedition spent about two months

is wholly incorrect. This morning he is in fine form, telling a long and rambling tale of a bandit hunt in this region. According to him, the desperate bandits eluded local posses, the army, the navy, and the air force, until they were finally captured by Baliña, single-handed, and brought to "town begging for mercy.

Williams has joined us, and we breakfast on "beefs of mutton," for "beef" or "bife" is not a particular kind of meat but a way of cooking it. Breakfast over, the cook does up a lunch of cold mutton (reserving another cut of mutton for dinner), and we get into our truck and drive off.

We jolt through the cañadón and a few miles from camp pass our nearest neighbors, members of a Boer colony that migrated from South Africa to Patagonia some years ago, to their intense regret. We are on a footing of aloof acquaint-

ance rather than of friendship, as the old couple speak only a few words of English and Spanish, and the youngsters, although fairly fluent in Spanish, are distrustful and shy. They are not used to the company of other human beings. Most of the Boers here dislike the English (which was their principal reason for leaving South Africa after the Boer war) and despise their Latin neighbors. They cannot be classed as a friendly group in general, although some individuals were very gracious to us.

Beyond the corrugated-iron hovel of this poverty-stricken family, the trail winds steeply up the side of the cañadón to come out on the Pampa Pelada, the Peeled Pampa, so called because even in this desolately barren land it is famous for its lack of vegetation. As we travel over its perfectly flat surface, we startle numerous little bands of guanacos. We chase one guanaco with the car and find



A VISITOR

The horse has a handsome homemade bridle and native saddle

that his greatest running speed is about thirty-five miles per hour. He cannot keep up that rate for long, and a good horse can always run a guanaco down unless the latter can get away into broken country where his excellent climbing ability permits him to escape easily.

We soon come to the point on the cañadón rim above our present place of work, and as we fill our canteens from the truck's water tank and sling on our knapsacks, Williams and I engage in our daily debate over the scenery. Perhaps most of mankind could be divided into desert-people and water-people. Desert-people love vast, solitary expanses, the bright hues of desert rocks, and the delicate purples of distant mountains. They feel at home in fantastic, sportive landscapes, boldly lunar, carved from pale ash and black lava and contorted red or orange sandstone. There is something sympathetic to them in



WINDY DAY

The wind whipping over the cañadón rim is so strong that one must lean against it to keep one's footing



COOKING AN OSTRICH

The ostrich (rhea) rump, with bones removed, is formed into a bag and filled with hot stones

limitless space, in keen, clear air, in boldly savage and barren country. To water-people all this is abominable. They want a more fertile environment, one at the same time less expansive, less brutal, and more varied and dynamic: the seashore, placid lakes, and cool, tree-shaded streams.

Williams, unfortunately for him now, is a water-person. I am more of the desert-people, and I love the scene spread before us now: the great cañadón falling away at our feet to its distant depths, a maze of sharp ridges and of deeply dissected gullies where panthers lurk; the almost black mountains, scores of miles away, their peaks severed from earth by mirage and seeming to hang shivering in space; and the hard, blue dome of the air in which eagles wheel and soar.

We plunge into this wilderness, sliding



A BETTER CLASS HOME

This mud house represents the best sort of home in central Patagonia, and is very like some in our southwest, even to the conical outdoor oven

and clattering over the ground. But we are resigned, especially as we know that the slightest lull in the almost eternal wind will bring clouds of flies swirling around us. It is January, midsummer, and at the height of the short fly season.

and jumping down steep slopes of dazzling white volcanic ash, and painfully groping our way up the sides of ravines, until we come to the scene of our labors. "La Oficina del Diablo,"—the Devil's Office—a local sheepherder called it one day when, to his amazement, he came upon us working there, and the name is as apt as any. It is a sort of natural amphitheater of Brobdingnagian proportions, almost completely devoid of vegetation, and excavated in the thick beds of volcanic ash. In the center rises a conical peak of the same ash, with streams of dark brown pebbles from the pampa above spilled down its sides, like a portion of vanilla ice-cream a quarter of a mile in diameter with a few tons of chocolate syrup poured over it.

The wind is blowing hard, as usual, and it fills eyes and hair and teeth with the knifelike fragments of ash and sends the dark pebbles blowing

Near the place where we have been working is the fresh carcass of a sheep with the breast torn out but otherwise untouched. Our hitherto unseen friend, a puma (or panther), has been around again. The big cat seems to like the Oficina del Diablo since we have been here and perhaps has left us the unused part of her kill as a token of esteem.

We set about working on the fossils we have already found, and hunting for new ones. I wish all the people who have asked me "how we know where to dig for fossils" could sit on the Ice-cream Peak and watch the process. I go walking over the bare face of the slope, cut



TYPICAL NATIVE HOME

Most structures in Patagonia are hovels largely made of corrugated iron. Members of a Boer family living in Cañadón Vaca, are shown here

HAULING WOOL

For long hauls great carts with wheels eight feet or more in diameter are used, but for shorter hauls on beaten tracks these smaller wagons are adequate



by wind and rain from the once deeply-buried beds of compact ash. I walk slowly, eyes glued to the ground. There is a loose fragment that seems to have a different shape and texture from the pebbles and ash-blocks. I pick it up.

Yes, it is a sliver of petrified bone. I get down on hands and knees and look around for more. There is another, a few inches farther up the little wash, and above that are several others. I follow them up until I come to the highest ones; they must be weathering out of the ash bed near here. Wash has covered any bone that may still be buried, so I scrape the surface with a small pick until the broken end of a bone is revealed. Then with pick and sharp, curved awls, enough of the rock is scraped away to show the form of the bone, and to see whether it is isolated or whether it may not be connected with other parts

of the skeleton. It is only a lone fragment of a limb bone, not worth collecting, so I leave it.

As I start on, my eye is caught by an object sticking out of the rock a few feet away. This is more like it! Here is a fragment of bone just beginning to be exposed by the constant erosion, and in it a tooth is showing—it must belong to a jaw or skull, perhaps broken, perhaps complete, but in either event worth collecting, for it has teeth, and from them can be determined the species of extinct animal to which they belong. And so I start digging to get it out. You see, all of you whom I have in imagination placed on the Ice-cream Peak to watch, how easy it is to know where to dig for fossils! You simply dig where you know there is a fossil.

Meanwhile, Williams is working on a skull found yesterday. The top has already been exposed,



AN ASADO

All the neighbors for many miles around gather for the "asado" or lamb barbecue. Pajama jackets for outdoor wear are considered very chic by the native men



PATAGONIAN SHEEP RANCH

This "puesto," a rude corral and a sheet-iron house, would be typical except for the very unusual luxury of an acre or two of coarse grass available as a paddock

just enough of it to see how large a block must be made to contain it, and leave it surrounded by the rock in which it is imbedded, as this will help hold it together during shipment and as cleaning the fragile bone is a long and delicate process much better done in a well equipped laboratory in New York. The top has then been soaked with shellac, to strengthen it and help hold it together, and to this has been applied thin rice paper, to give a firm surface and to keep bandages from sticking tight to the specimen itself. Then the bandages were applied, strips of burlap soaked in flour paste. These have dried and formed a hard shell which holds the specimen together and will protect it during the long journey ahead of it. Now Williams cuts a deep channel around the specimen, which is still exactly in the position in which it was found and as it had been buried so many millions of years ago. The channel cut, he carefully undercuts the block. If it were larger, he would tunnel under it

and apply inches to keep the bottom from falling out, but it is little more than a foot in diameter and so does not require this. Soon it is supported only on a thin pillar; this is broken and the block rolled over. Now the bottom is trimmed away until bone is reached, and shellac, paper, and bandages are applied to this side as they already have been to the other. As soon as it is dry, it will be ready to take to camp.

Later the bandaged block will be taken to Comodoro Rivadavia, Metropolis of Patagonia, and there packed with others in stout boxes and shipped by boat to Buenos Aires. In Buenos Aires, government officials will examine the boxes and give a permit to export them. Then they will start on the eighteen-day voyage to New York, where they will finally come to rest in the American Museum. A preparator will unpack the box and place the block on a temporary plaster bed. The bandages, paper, and surface shellac will be carefully taken off one



A NATURAL GEM

This lovely cluster of elaborately twinned crystals on translucent white chalcodony might be a triumph of lapidary art, but they were formed naturally in the depths of ancient volcanic strata

side and the rock scraped and chiseled away from the bone, then the specimen will be turned over and the process repeated on the other side, finally freeing the bone and resurrecting it from the ash in which it was entombed ages before man came into existence. Cracks and missing fragments in the skull and jaws will be filled in with plaster and the completely prepared specimen shellacked again to preserve it from moisture.

Then the specimen will go from the laboratory to my office where I will measure it and study it, comparing it with any similar animals previously known. If it is new, I will give it a name and publish a description of it in the scientific publications of the Museum. Finally, two or three years after this day when we are collecting it and forty or fifty million years after the live animal roamed the plains of ancient Patagonia, work on the skull will be complete and it will be placed on exhibition in the Museum.

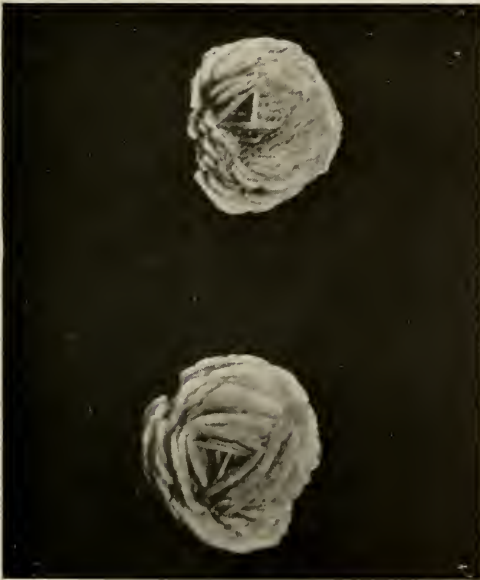


STUCK AGAIN

Although being stuck with the car was almost a normal state and seldom serious for the expedition, occasionally it meant days of delay to get together enough horses to pull it out

But all that lies in the future now, for we are still in Patagonia with months of field work ahead of us. While we have been working, clouds have rolled up from the west and the sky has become overcast. Suddenly rain begins to fall with stinging force. As uncovered or bandaged specimens may be seriously damaged by water, we hastily cover them, and crawl under a rock ledge near by where it is still fairly dry. With water pouring over the ledge in a cataract, forming a veil between us and the outer world, we eat our lunch and roll cigarettes of rank, black, hairlike native tobacco.

There has been an unusual amount of rain lately, and it seriously interferes with our work. It is extremely difficult to prospect for specimens on wet days, and impossible to collect them properly, so that rain brings work almost to a standstill. Fortunately the rain soaks into the ground almost at once and dries up quickly in the dry wind. This noon



PATAGONIAN ROSES

These "desert roses" of Patagonia, delicately shaded and sculptured, do not have soft petals but are hard as rock, composed of curiously interlocked mineral crystals



FINISHING TOUCHES

A specimen from the Oficina del Diablo in the laboratory of the American Museum in New York, a year after its collection in Patagonia, being prepared for study and exhibition by Carl Sorensen. These are the complete skull and jaws of *Thomashuxleya*, one of the largest animals of its very remote epoch, hitherto known only from fragments

it is only a passing shower, and after lunch we are able to uncover the specimen again and go back to work.

Toward the end of the afternoon a man comes riding up on horseback. Although he is a Boer, like everyone who lives around Cañadón Vaea, he is more *acriollado*, Argentinized, than most of his compatriots, and rides in native fashion, with only one stirrup which serves for mounting and is usually not used in riding. He has a native saddle, too, consisting of two cylindrical leather pads, one on either side of the horse's sharp backbone, over which are piled several sheepskins and a soft, tanned piece of cool, porous carpineho hide. Such a saddle is very soft, but the posture required to ride it is most uncomfortable to one unaccustomed to it, like riding on a backless and armless, greatly overstuffed rocking-chair.

Although annoying to us, the rain has been very convenient to our visitor. For weeks he has been trying to catch our nocturnal prowler, the puma. Today the big cat was out during the rain and left tracks in the mud when she went back to her lair. Our visitor and another neighbor (and by "neighbor," I should have said, I mean anyone living within twenty-five or thirty miles, which includes three families in this case)—our visitor and another neighbor found the tracks and trailed the puma to her den. They had not found it before, because their hunting dogs, galgos, hunt by sight and could not follow the scent and because the puma never left a visible trail on dry ground. The den proved to be a small cave under a rock ledge, very similar to that in which we had lunch and about half a mile away. They sent the dogs in to get the cat, but a puma

at close quarters and with its back to the wall is too much for any dogs and, after one trial, the galgos retreated rapidly and in bad order. Finally the entrance to the hole was enlarged, flaming bushes were thrown in, and the pumas were shot as they came out—for there proved to be not only the old one, an unusually large female, about seven feet long, but also two cubs, each as large as the dogs.

The hunter has one of the dead cubs slung over the horse's back, which surprises me as the horses I have known in North America would have hysterics at this. Our visitor assures me that most horses here would not like it, either, but that this horse has a phlegmatic Nordic temperament. After a short smoke and chat, the hunter goes on his way, happy that there are three fewer pumas to kill his sheep.

Before sunset the sky once more darkens and we decide to hit for home. As we

climb laboriously up to the pampa, the rain again falls in torrents, and, soaked through and shivering, we reach the car. While we are starting, the rain changes to a drizzle and mist closes in so that we can see only a few feet in any direction. After running for half an hour, we have not come to an expected landmark on the almost featureless pampa, so we stop, walk away from the car to get out of its magnetic influence, and plot a new course with the compass. By repeating this process several times we finally reach the ravine down which we must go. While navigating without the compass, we had made almost a complete circle, and would not have gotten off the pampa safely at least until the storm cleared, had we not had more faith in the instrument than in our own thoroughly disoriented sense of direction.

Getting down off the pampa with the



IDENTIFYING A FOSSIL FROM THE OFICINA DEL DIABLO

The last stage of the long task before the specimens are placed on exhibition or added to the study series. Each must be carefully examined, measured, and compared with all previously known kinds of extinct animals. If new, like this jaw from the Oficina del Diablo, they must be named, described, and illustrated in the technical publications of the Museum

car is dangerous and rather nerve-racking, for it is impossible to steer in this slimy mud, and we can only start the car in the right direction down the steep slope and trust to luck, which proves to be with us, and we land right side up. In the middle of the cañadón we get thoroughly stuck in the softened sand of the normally dry water-course, but that is all in the day's work, too, and half an hour of digging and filling gets us out again.

We reach camp sometime after dark, feeling tired and bedraggled, but a few boiling hot matés revive us thoroughly and we are ready for our third heavy meal of mutton, this time in the form of estofado, boiled with numerous sorts of spices. The cook also has some fresh tortas fritas, of which we are very fond, not unlike American baking-powder biscuits but fried in deep fat (mutton grease, of course), like doughnuts.

After dinner I have to work on the expedition records. As each important specimen is found it is given a field number which is marked on it, or on its bandages,

paper wrapping, etc. The number must then be entered in a notebook with full and exact data, the geological horizon, geographic locality, nature of the specimen, date, and name of the collector. Without such records the specimens would have very little scientific value. There are also many other things to do besides the actual collecting, both in the field and camp. Maps must be made, rock strata described and samples taken, geologic structures observed and recorded, cross sections of the fossil fields made with the exact levels of all specimens marked and a journal of the progress of the expedition kept up to date. Each night the information gathered in the field must be transferred from rough notes, written in wind and, often, rain, hastily and with numbed, clumsy fingers, into neater and more legible form in permanent notebooks, and observations and comments entered while they are freshly in mind.

This done, I happily roll up in my fur blanket and instantly fall asleep. The day is over.



THE PEELED PAMPA

This is the most typical scenery of central Patagonia: the high pampa, almost perfectly flat, covered with pebbles between which grow a few tiny shrubs, and with a flock of guanacos ambling away

Courtesy of
Ivar Arwidsson



BUSH-MOUSE

JERBOAS, KANGAROO RATS, AND JUMPING MICE

Track Stars of Desert and Meadow

By ROBERT T. HATT

Assistant Curator, Department of Mammals, American Museum

THE course of organic evolution has been replete with instances of widely different lines of animals converging toward similar body type. Such convergence, or parallel evolution, has probably never been so complete as to hide the independent origins, but the wonder remains that the animal form has proved so plastic under the molding influence of environment. An active pelagic life led to the assumption of similar external forms in sharks, ichthyosaurs, and porpoises, and yet an examination of the whole, or almost any fragment of the bodies of these animals would show that one was an elasmobranch fish, one a reptile, and one a mammal.

Adaptation to leaping locomotion has been one of the most frequently occurring specializations among the mammals, and bipedal leaping types occur in three of the living orders, representing at least seven independent evolutions. The jumping marsupials are represented by kangaroos and their allies, and a peculiar,

small, carnivorous creature named in books the jerboa pouched mouse (*Antechinomys*). A family of leaping insectivores is confined to Africa, where, to measure success by the rule of abundance and diversity, the group is fairly prosperous.

It has, however, remained for the rodents, most successful of all mammalian orders, to produce a wealth of bipedal species, and it is with these last that the present article deals. The English, or "popular" names bestowed upon the widely differing creatures scarcely indicate the extent of their evolution, but since the simple nomenclature used for scientific designation remains unfamiliar among laymen, it is best ignored when other names are available.

The most notably successful of bipedal rodents may be reviewed by way of introduction.

The spring haas, or African jumping hare, is the largest bipedal rodent, and, as suggested by its name, is about the size of a rabbit. The animal inhabits



Photograph by W. S. Berridge

AUSTRALIA'S JERBOA MOUSE

Living alongside the one-hundred-and-sixty pound kangaroos, this two-ounce mouse excels the more familiar marsupial in leaping ability



Courtesy of Ivar Arwidsson

BALANCE

Up in the brush the outer toe of the foot of the bush-mouse hooks about the twigs and the tail curls around other branches, actions of which its cousins, the jumping mice, are incapable

dry regions from the Cape of Good Hope to Kenya Colony. Like all of the other leapers in the order it is nocturnal, spending the daylight hours in burrows. The toes of its rear feet are tipped with heavy hooflike claws.

The kangaroo rats are an abundant lot of species, living in the arid parts of the western United States and northern Mexico. None are larger than a house rat and none possess that animal's unpleasant ways, though stock raisers find them competitors for forage. In a small area centering in Nevada there is a closely related jumper, the kangaroo mouse, or pigmy kangaroo rat.

Another saltator that is a true mouse, lives in the Australian desert to the north of its marsupial simulant. It is generally called the jerboa mouse. Other less-known species live in New Guinea and in Madagascar.

Of all the gnawers specializing in

bounding none equal in richness of types or perfection of adaptation the family Dipodidæ, a natural group whose members, except for the aberrant climbing bush-mouse of Europe and Asia, are all primarily bipedal. The group probably originated in Central Asia. One early migratory wave, the jumping mice, wandered far, one part of it moving into Szechwan, the other crossing over into North America. Succeeding evolutions, the jerboas, spread into southeastern Europe and across the chain of deserts into North Africa. Asia, however, remains the homeland of the group and in this continental area we find today ten genera of highly saltatorial types. One could coin names for all of these, but it is perhaps enough to call all of them jerboas and to note that among them are species with five toes and others with three toes on the hind feet; jerboas moderately



Courtesy of Ivar Arwidsson

SICISTA

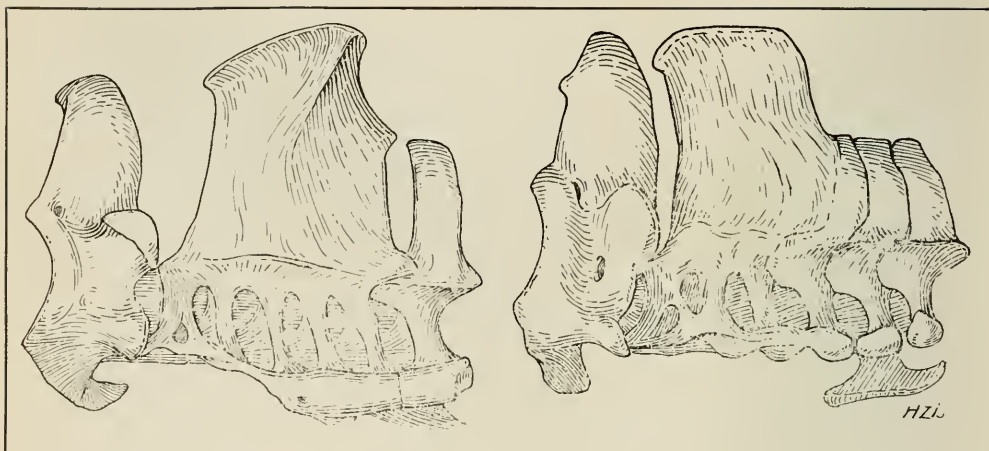
Europe's bush-mouse is near the root of the family tree of the jerboas and might be called a living fossil. Though itself a capable jumper, its feet and tail fit it particularly for climbing



Photograph by W. S. Berridge

EGYPTIAN JERBOA

The culmination of jumping ability is represented by the three-toed jerboas. Long rear legs, heavily bristled under the toes, and a long, balancing tail are only the most obvious of their many specializations



PARALLELISM

All bipedal rodents have short necks. In the two instances here shown, of animals no more nearly related than are horses and rhinoceroses, the central neck vertebrae are fused together. On the left is a jerboa, on the right a kangaroo rat

large, others of small size; species which hop and others which both hop and run.

The geographical distribution of saltatory rodents shows a striking correlation with desert areas. In fact, virtually all species except our American jumping mice live in arid, open country, and since these are less specialized than the xerophilic bouncers they only serve to bolster the theory that desert conditions are highly favorable to the development of leaping habits, at the same time that their existence proves that such locomotion may be of use in another milieu. So strong is this association between deserts and jumpers that these rodents may be found in all the major dry areas of Eurasia, Africa, Australia, and North America. South America alone is without a bipedal species.

The extent of the association between deserts and bipedal leaping rodents suggests a causal relation between structure and environment. It is usual that the relation is interpreted as the result of

environmental selection of fortuitous heritable variations, though in the minds of many the environment is credited with a directional control of variation in such cases as this.

What factors in a desert environment might place a premium on the development of a swift gait and artful dodging?

The dominant and invariable feature of deserts is aridity. This results in three inhospitable characteristics to which desert living mammals must become adapted. The first of these is the lack of water for drinking purposes; the second, an extreme diurnal temperature cycle in consequence of the absence of an ameliorating blanket of moisture in the air; and the third, a paucity of vegetation to furnish food and cover.

The desert mammals must thus do without water, travel

far to find it, or develop extraordinary means of conserving the meager supply. Popular superstition credits the prairie dog with sinking its den to water, but this explanation, though less fantastic



WHEN THE KANGAROO RAT GETS UP SPEED, THE REAR FEET FAR OVERSTEP THE FORE FEET

than the real one, is without foundation. These and other herbivorous types are largely dependent on the water content of their food to supply their needs. Perspiration in desert mammals is rare and the smaller species avoid the hours of greatest evaporation by remaining in the ground during the day.

The extent to which these little rodents can do without water is not quantitatively known, but there are many instances of animals kept in captivity that never drank, even when they received no moist food. A kangaroo rat in my possession for two and one half years, and still alive, never takes water or other liquids. Though some small amount of green vegetable matter is eaten, his usual diet is of dry rolled oats, sunflower seed, and flax seed.

The enemy Heat has been avoided rather than tolerated, and the small mammals all escape the high temperatures of midday by remaining in

burrows or in voluminous, heat-insulated nests of their own construction. The necessity for this escape and its relative ease are shown by temperature records from the desert. On the soil surface of the Sahara 182° F. has been recorded, and in Arizona a daily range of 130° F. (54.5° C.) is known. At this latter station the soil two feet below the surface showed no change in temperature through the twenty-four hour period, so it is obvious that very deep burrows are unnecessary.

Sparseness of vegetation is far-reaching in its influences. Much of the little flora is inhospitable to the mammals because of its spinescence and hard-fibered texture. Food and shelter are thus reduced to the minimum. Even the surface soil reflects the flora by the absence of accumulated plant débris. Blowing sand is common, exposed rock frequent. Ages of soil bleaching and accumulation of alkali give a light hue to the typical desert



A KANGAROO RAT BOUNCING ALONG ON HIS REAR LEGS AS ON TWIN POGO STICKS, SWERVES HIS TAIL FROM SIDE TO SIDE TO MAINTAIN BALANCE



LEAPER'S FRAME-WORK

The skiagraph reveals the great curve of the vertebral column, the sharp flexure of the short neck, the inflation of the back of the skull, and the enormous disproportion of the fore and hind limbs, characteristic of many leaping rodents

Courtesy of Elsie-Marie Holzman

landscape. Rodent species under these conditions must change their ancestral habits in order to live in such harsh surroundings. When living against light backgrounds they have, in most cases, developed an obliterative light-hued pelage. On sandy areas they have grown hairy coats on their feet. It is established that kangaroo rats inhabiting the sandier areas are equipped with hairier feet than those living on other soils. A similar correlation appears in the jerboas. Some of these have great brushes of stiff hairs on the underside of their feet, which doubtless serve not only as a defence against the sand, but also as shock absorbers at the moment of landing. One species has a comb of strong, horny bristles on each foot, but the significance of this structure in relation to habitat or habits does not seem to be known.

Thus to the physical and floral aspects of the desert the small rodents are fitted. The predators have yet to be dealt with. Nature, however, has many tricks for maintaining the numbers of the vegetable eaters, among these high fecundity, armor, and speed. None of the bipedal rodents employ the first two, while their

individual lives may every day depend upon the last, coupled with good reception by well developed eyes and ears.

The eyes are enlarged in the jerboas and kangaroo rats to an extent not exceeded in the mammals except by some of the tree-living, nocturnal species. This gives the leaping rodents a double advantage, the ability to see the enemy with less light than would be required by a small-eyed mammal, and the means to obey the old adage, "look before you leap."

A few of these springing specialists have enlarged and lengthened the external ear, the better to catch sound. Such is the five-toed jerboa, named by the Germans "horse springer," for its horselike or asslike ears. Other jerboas have the base of the ear-conch tubular, and the spring haas possesses the ability to fold its ears closed, the better to exclude flying sand. Within the limits of the skull have occurred greater changes.

One of the most striking parallelisms among unrelated groups of rodents living under similar environmental conditions, is the occurrence of enormously inflated bubbles of bone, the bullæ. The inflation of these bullæ reaches extremes in the



Courtesy of Anatol Argyropulo

URAL BUSH-MOUSE

Observations of Russian naturalists show that, when on the ground, the primitive bush-mouse progresses in much the same manner as its nearest relatives, the American jumping mice



Courtesy of E. R. Warren

COLORADO JUMPING MOUSE

These mice leap out with the abruptness of clay pigeons, and keep on jumping. They sometimes cover forty times their body length at a single bound

Asiatic pigmy jerboa (*Salpingotus*), and the American kangaroo mouse (*Microdipodops*). Their modification is supposed to serve for better audition, the enlarged chambers acting, probably, as resonators. Similarly enlarged bullæ are found in many desert mammals in all parts of the world.

The noses of these creatures are of little service, since a dry atmosphere does not carry odors well. The most notable changes in the nose have not to do with smell, but with protecting the nostrils in digging activities and, presumably, from blowing sand.

It is hardly surprising to find large ears and big eyes so common among the desert mammals. But acute hearing and good sight are of little use to an animal whose enemies are swift unless the means to escape is present, and so the desert harbors many animals supreme in the attribute of speed and artful dodging. No sort of locomotion short of flying approaches the long series of bipedal leaps for either of these two qualities. One spring may propel a jumping mouse forty times its body length. To attain such power the rear feet and legs are

exceedingly elongated, thus increasing the length of extension for the catapultic function. The muscles operating the leg are augmented in bulk, the feet strengthened by the development of hingelike joints with movements limited to the vertical plane. So bounding has this locomotion become that by analogy it is called the ricochet, and the animals employing it are termed ricochetors.

Ricochetal locomotion is a wasteful method of progression since so much energy is expended in the production of the upward movement, energy diverted at a right angle to the line of progress. The movement of a wheel represents the least wasteful of all types of movement, for here the center of gravity remains at exactly the same horizon and there is no waste of energy. Though mammals have never developed wheels in place of legs they have developed some types of locomotion that involve very little expenditure of energy in the vertical plane. Such, for example, are the running gaits of men and of some jerboas and the "single-foot" gait of a good riding horse.

How is the wasteful expenditure of energy justified? Beyond question it is



Courtesy of Anatol Argyropulo

WELL BRACED

The feeding bush-mouse sits with feet spread wide

on the basis that there is some gain in speed by the use of such bounds, and, of greater value, an enhancement of the ability to dodge. For animals living in open country, much at the mercy of the predaceous world, these two blessings must far outweigh the little matter of conservation of energy. From a jerboa's point of view there is no advantage in saving energy for the use of an unfriendly fox.

The ricochet is poorly suited to large animals where the ratio of strength to weight is less than in smaller creatures. It is true that some kangaroos are large animals and we know by the fossil record that one species attained a weight near 400 pounds. These animals, however, are the exceptions to the rule, and bounding movements are notably less common in large mammals than among small, as well as less efficient, since the giant kangaroos cannot cover distances in excess of five times their body length.

The new problem of balance entailed

in bipedalism has been solved in the shift to the rear of the fore part of the body, a dwarfing of the fore legs and the over-development of the tail. In this way the center of gravity tends to fall near the point of support rather than farther forward, as in the old quadrupedal types, and the tail helps to balance the front. Coupled with these changes there has been an alteration of the old muscle-bone pattern of the spinal column to a single cantilever system holding up the fore part of the body when the animal is on its rear legs. Of course the old double cantilever has not disappeared as the forelimbs are not functionless, but it is suppressed in favor of a cantilever operating from the sacrum. The process of shortening of the fore part of the body is coupled with a reduction in flexibility of movement of the column. Thus the neck in the most perfectly adapted of ricochetors is reduced to about one-half



BALANCERS

Hopping requires balance and the tails play a major rôle. Some leapers have them short and fat, others long and thin. The commonest type bears a brush at the tip of a long tail



Painting by Charles R. Knight

AFRICAN JUMPING SHREWS

With long heads, necks, and fore legs, and with comparatively short, naked tails, these animals do not closely parallel the leaping rodents, but are, in their forested terrain, among the best of jumpers

the length found in the generalized quadrupedal types. Under such circumstances it is inevitable that motions of the neck are greatly curtailed, and it is thus scarcely surprising that fusion of elements of the cervical vertebræ has taken place, independently in three or more evolutions. Simplification in this case increases strength.

With shortening of the neck there has also been a lessening of the angle formed between the neck and the back, this change also being in the nature of a posterior displacement of the center of gravity.

It is of particular interest that different systems of tail balance have appeared in closely related jumping rodents, as similar systems have arisen in the most widely separated groups. Among one great group of leapers, the Dipodidæ, or jerboas and jumping mice, are found tails which are long and thin, without extensive hairing, others short and fat, simi-

larly unhaired, tails moderately long and bearing a big brush at the end, and lastly, in one species a tail short and completely covered with a rich coat of hair. The short, thick tail type occurs in almost all leaping marsupials, the bipedal insectivores, in one of the jerboas, and in the American pigmy kangaroo rat. The long, thin tail occurs in Asiatic pigmy jerboas and in American jumping mice. The moderately long, tufted tail has been the chief specialization of the jerboa group, the kangaroo rats, a bipedal marsupial, the Australian jerboa mouse and various groups of rodents which appear on the verge of evolving into bipedal stock. The hairy brush of the tail tip of the kangaroo rats is commonly laterally compressed into dorsal and ventral keels, rather than dorso-ventrally in the manner of the commoner genera of jerboas. In Merriam's kangaroo rat, which lives in Arizona, the tail of the sitting or slowly hopping animal

is usually in contact with the earth about three quarters of an inch from the tip, while the tip is curled up. Because of this position the ventral hairy keel persists. Available observations suggest the rôle of guiding vanes for these vertical blades of hairs, whereas the horizontal blades of hair in the jerboas are useful in furnishing support to the animal leaning back on the tail when on the sand. That these brushes in both groups serve multiple purposes of support, guidance, balance, and display of an enemy-distracting pattern is very probable.

The fore feet, though dispensable for purposes of locomotion, are in no sense useless vestiges. It is with these members that the long tunnels are dug and with which, in the kangaroo rats, the cheek pouches are filled with food. Though I have never been able to witness the action,

I deem it probable that the cheek pouches are also emptied with these hands.

The ricochetors, one may see, have had an eventful past. Their ancestors pioneered and suffered all the privations and torture of Oregon Trailers. White fangs and cavernous red mouths were constantly after them. By luck their physical resources increased, and this metamorphosis meant the change of the desert from a dry, hot hell, to a home compared to which the old, pastoral lands seemed damp and crowded.

What is their future? That I cannot predict, though if my advice were solicited, I would suggest they add wings for increasing their glides. More likely, these exponents of a fast and vigorous life will settle down and grow fat, for man with trap, gun, and poison is removing their chief incentive to speed.



KANGAROO RAT
Painting by Fred Mason



A Refuge for Many Water Birds

THE AVO-CHIC

An Avocet of the Colorado Prairies Unwittingly Becomes
the Foster Mother of a Domestic Chicken

BY ALFRED M. BAILEY AND ROBERT J. NIEDRACH

PHOTOGRAPHS BY THE AUTHORS

COLORADO in springtime is subject to many moods. Smiling, cloud-flecked skies and gentle winds alternate with dark, gusty days when rain or snow squalls sweep across the prairies, and the mountain tops are hidden beneath mantles of sullen gray. But it is the time for the outdoor photographer to be afield, for all nature is awakening; the brown prairies are freshened with patches of green, the naked, deciduous trees become clothed, and the winged migrants arrive from their distant wintering grounds.

The prairie ponds are places of refuge for many species of water birds, and the noisiest and most conspicuous of all are the avocets. They are long-legged shore birds which nest commonly in the short grass bordering the alkali pools, and when an intruder wanders near their domain, they come to meet him with loud, strident

cries. As many pairs may nest in one locality, a dozen or more will often be circling about, voicing their displeasure.

We had known the avocets as friends for years, but like many others, our friendship had always been a rather distant one. We had visited their homes, held their youngsters in the palms of our hands, and then gone away, well satisfied with the few minutes we had spent with them. And from the parting remarks of the avocets, we are sure that they were not reluctant to have us leave.

This past spring, however, was a little different from other seasons. In previous times, we always said we were going to get better acquainted with our avocet neighbors—and then we let the season roll by without making the attempt. But this time we made good our promise. We were making motion films for the Chicago Academy of Sciences and the

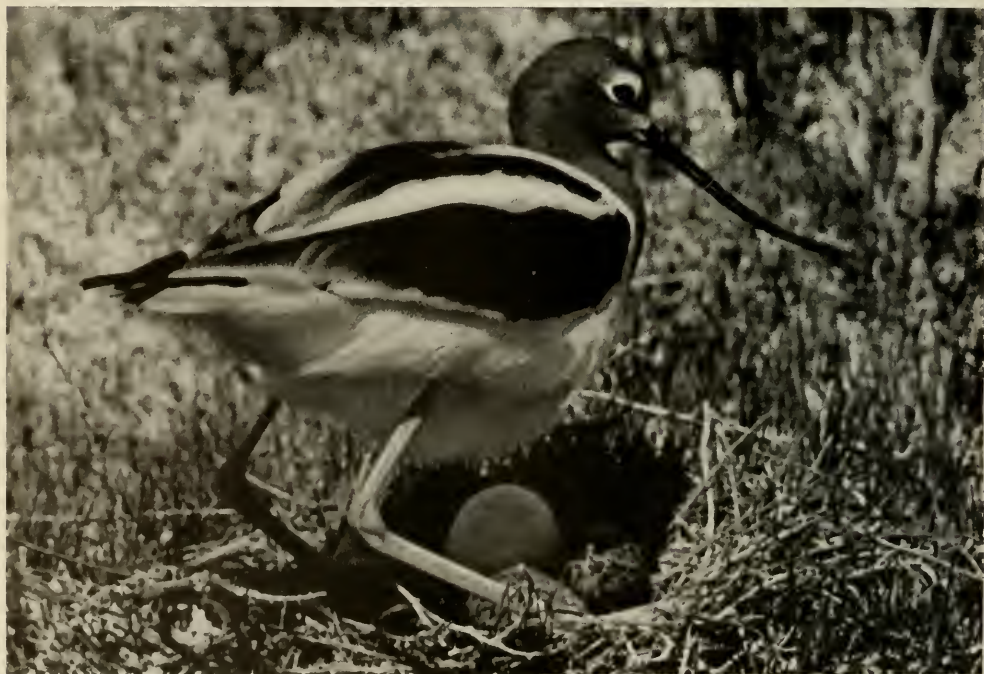


THE EGGS OF THE AVOCET

Although the eggs of this long-legged shore bird are rarely hidden in the grass, they are so protectively colored that it is most difficult to find them

Colorado Museum of Natural History, with our companion, F. R. Dickinson, and we found ideal conditions for the work near some little lakes a few miles east of Denver. Many species of water birds were nesting, and the avocets were abundant. Our procedure was simple enough. We merely drove our car within fifty feet of the pond, stirred up all the birds nesting in the vicinity, and then, with our binoculars, marked down the various individuals as they returned to their nests.

We found an avocet ideally situated for picture work. The long, slender fellows hovered overhead on quivering wing as we set up our blind, cursing us heartily. Occasionally they would alight some distance away, run toward us with outstretched wings, and then turn, as though to invite us to chase them. The blind erected, our camera equipment was put in place, a comfortable chair was arranged



UNCONCERNED

"Old Faithful," as the photographers named the star of their drama, appeared not to notice the large white chicken egg which had been placed in the nest



THE AMERICAN AVOCET

The avocet gently lowered herself upon the eggs and then gazed calmly at the blind—in spite of the whirring of motion film

for the camera man, and the others left him to himself.

What a view the photographer had to the westward! The shallow alkali pond in the foreground was bordered with fast growing marsh plants. Avocets waded along the borders, Wilson's phalarope rode buoyantly upon the surface, and occasional pairs of pintail or teal passed swiftly by. On the horizon were the blue foothills with the rugged snow-capped crests of the Continental Divide thrust into the blue of the cloud-studded sky. With such a setting, one could never grow weary.

But the avocets were not particularly wary. They fed nonchalantly along the borders of the pond, with the camera man keeping an eye upon them, using a slit through the canvas as an observation peep hole.

One of the birds finally took wing and alighted across the lake with some other



IMPOSING ON GOOD NATURE

Does a bird recognize her own eggs, or does she return to a certain locality? To test the avocet's reaction, a chicken egg was substituted in the nest for one of her own



OLD FAITHFUL EYED THE BLIND

The bird paid no attention to the large white eggs, even though they were nearly three times the bulk of her own protectively colored ones

waders, and so it was necessary to watch only the one bird. The old fellow walked back and forth, feeding occasionally and stopping now and then to rest and to preen its back feathers. It seemed to show no concern for the near-by blind. The photographer looked across the lake, but could not identify his other avocet among the numerous birds assembled in the shallows, so, to pass the time away, he decided to check up on his focus. Placing his eye against the lens which allowed him to focus upon the nest, he was somewhat surprised to find an avocet, which filled the ground glass, gazing calmly at the blind! His bird was patiently sitting upon the eggs, waiting for its portrait to be made!

As a motionless bird is not exactly what is needed for motion pictures, she was

frightened from the eggs with a slight movement of the canvas, and in a few moments, when she returned and folded her long legs beneath her, the performance was registered to the entire satisfaction of the man turning the crank.

We learned to call this avocet "Old Faithful," in the days that passed, for we decided to perform an experiment with her, and she responded nobly. When we have shown our motion films of the great tern colonies of the Louisiana gulf coast, with thousands of eggs scattered over the shell key, and the thousands of shrieking Royal and Cabot terns whirling through the air, people invariably have asked, "How does the bird

know its own egg?" We have always felt that a bird does not always know its own egg, but instead, that it returns to a certain locality. It is true that birds will often accept their eggs, if the nest is moved a short distance away, but we also felt that a bird would accept substitutes if her own eggs were taken away. So we decided to see what an avocet would do if we should place a chicken egg in her nest. Shore bird eggs are protectively colored; it is almost impossible to see them, even when you know where to look, so we secured the lightest colored, largest, and most conspicuous chicken eggs we could find for the experiment.

A chicken egg was placed in the nest and one of the avocet's was removed. In comparison, the white one seemed three

times as large as the dark colored eggs, but when the long-legged wader came stalking to the nest, it showed not the slightest concern, and settled down without hesitation. So the blind was shaken to frighten her off, and the camera man crawled out and substituted another egg. It seemed to make no difference to "Old Faithful," for, after flying about the blind for a few minutes, she finally alighted a short distance away, and then rapidly approached the nest, rearranged the eggs with her upturned beak, and fluffed her breast feathers over them.

Old Faithful was allowed to warm her eggs thoroughly before being flushed a third time; then another white egg was placed in the nest and one of the avocet's removed. She was rather querulous in her complaints as she stood some distance away, scolding in strident tones, but after her tormenter had concealed himself, she seemed to forget all about her trouble and quickly returned. She had a little

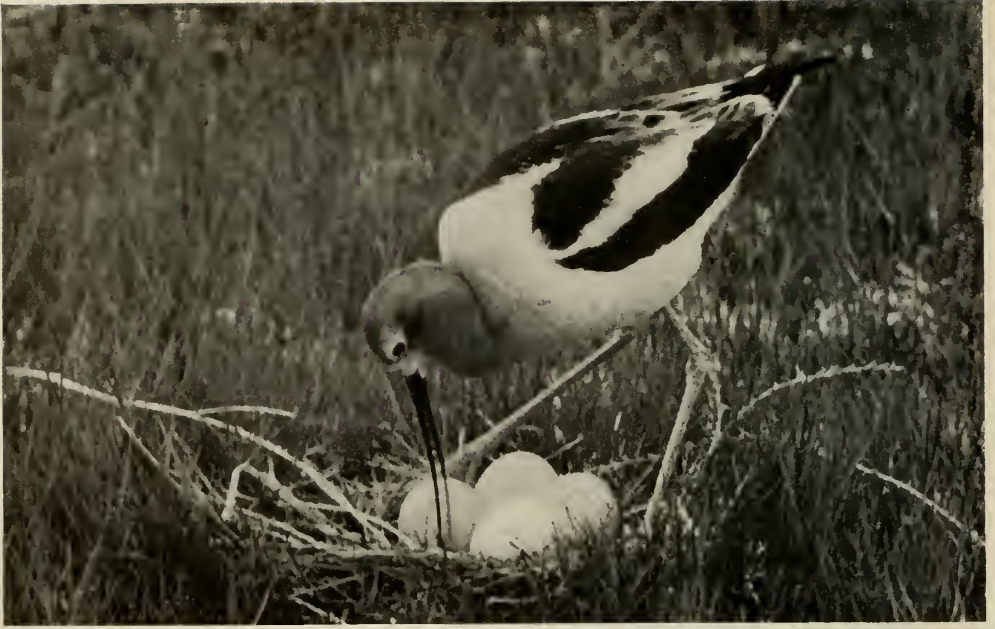
difficulty in spreading herself over the contents of her nest by this time, and seemed a little nervous, so the experimenter was undecided as to just how far he should proceed. He waved to his waiting companions, who had been watching the show with their binoculars, and they came across the meadow, raising a cloud of alkali dust with every step.

Should we give the old bird the fourth egg, and take the chance of her abandoning her nest, or should we be satisfied, and replace her eggs? One of the party protested that the avocet was merely making the best of a bad bargain,—that we had proved nothing; she still had an egg of her own, and was incubating it, in spite of the other objects which had been thrust upon her. We decided she would have to suffer further indignities. Her last egg was taken, and that of a domestic bird was put in its place. The two men returned to the car while the other stood over his machine, ready to grind off film.



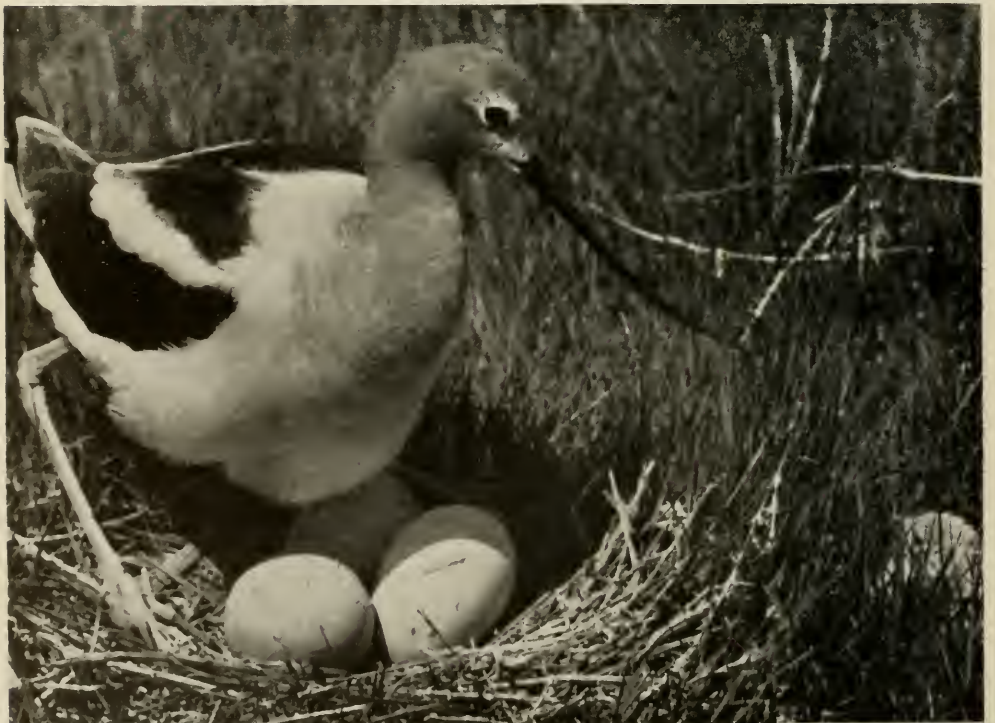
A DIFFICULT TASK

The avocet found it difficult to cover the large chicken eggs, but she seemed unconcerned



INSPECTION TIME

When the fourth white egg was placed in the nest, the avocet looked them over and shoved a few blades of grass into place



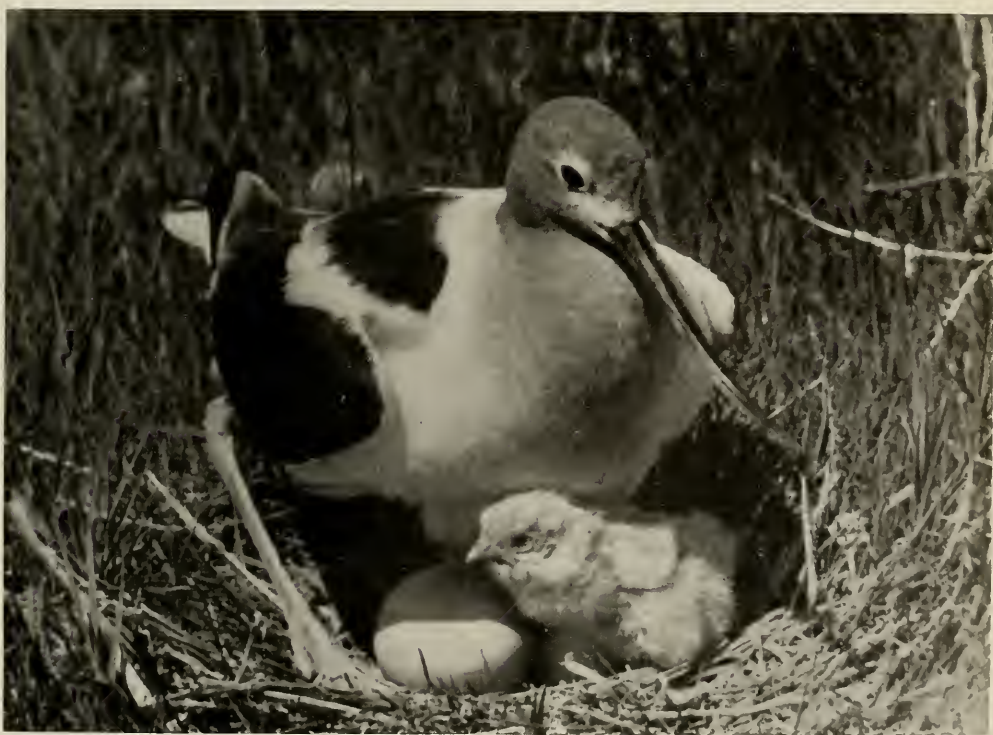
THREE WEEKS HAVE PASSED

The avo-chic dived over the side of the nest when the camera began to whirl, and remained hidden until the avocet returned



THERE WAS NO HESITATION

She stood over the nest with legs wide apart, spread her breast feathers, and gently lowered herself upon the chicken eggs



THE MOTHER AND THE CHILD

When the parent returned, the downy youngster crawled back upon the nest to the shelter of Old Faithful's protecting wings



THE PRAIRIE PRIMROSE

The prairies are covered with wild flowers in the early spring. Masses of prairie primroses were scattered over the level expanse, their white heads nodding with every breeze

He did not have long to wait, for Old Faithful seemed anxious to return; she stood over her nest with legs wide apart, spread her breast feathers, and after some effort, finally covered the eggs. There was no hesitation; she was perfectly satisfied.

We had merely intended to observe her reactions, return her eggs, and go about our business, but the avocet seemed so content with her possessions that we allowed the substitution to stand. We realized that there was only one chance in a thousand of a bird nesting in the short grass of the prairie to succeed in incubating such conspicuous eggs; we knew nothing of the comparative body temperature of the shore bird and the chicken, but as long as the bird did not seem to mind, we thought it worth while to allow her to continue her task.

We made many visits in the days that followed, and we always found Old Faith-

ful on the job. We noticed the poor bird seemed rather crippled, as though with rheumatism, and it was not strange, considering the size of the eggs she was attempting to cover, but she quickly returned after we had left the near vicinity. Once we found a boy attending to cattle in an adjacent field, and the boy's dog was keeping all the nesting birds in a turmoil. Old Faithful was not on her nest and the eggs seemed extremely hot, for it was mid-day and the sun was pouring down from a clear sky. We caught the dog and tied him up, and were glad to see our avocet return to her duty. The eggs must have been uncomfortably warm.

Finally, three weeks had passed. There was a great change in the appearance of the prairie, for there was a succession of many species of wild flowers. Masses of prairie primroses were now scattered over the level expanse, their white heads nodding with every breeze. And we

found that things had been happening at our nest, for as we approached we saw a broken shell, and there was a yellow chick just hatched, with the down still wet. It crouched in the bottom of the nest while the old bird circled anxiously about, attempting to decoy us away by pretending to have broken wings and legs. Her condition seemed little short of pitiful! We put the blind in place, the camera was trained on the nest, and the photographer was left to himself. The avocets ceased their swearing and all was quiet. It is always customary to make a few feet of film so the arrival of the old one will not

be too abrupt; with the first whirr of the camera, the baby chicken dived over the side of the nest and crouched motionless! It was as wild as the young of any wild bird, and it remained hidden until Old Faithful returned to her task of incubation. Then the little yellow head came out of the grass, and while the camera man ground off film, the baby chicken tottered out of its place of concealment, climbed upon the nest, reached rather feebly for the avocet's beak, and when the old one raised itself from the nest, quickly crawled under cover of the protecting wings.



THE AVO-CHIC



Mishkin Photograph

HENRY FAIRFIELD OSBORN

For twenty-five years President of the American Museum of Natural History, a post which he has brilliantly occupied as a scientist of preëminent attainments and an executive of unusual ability. Following his resignation as President, the Board of Trustees elected Professor Osborn to the position of Honorary President

THE RETIRING AND THE NEW

HAVING served for twenty-five years as president of the American Museum, Henry Fairfield Osborn resigned on January 10, 1933, and was succeeded by Frederick Trubee Davison.

In electing Mr. Davison to fill the position that has been so brilliantly occupied by Doctor Osborn, the Trustees of the Museum also elected Doctor Osborn to the position of Honorary President, a post that he will occupy in addition to the

positions he has long held on the Scientific Staff of the Museum. Always deeply interested in his work in the field of palæontology, Doctor Osborn has been forced to spend much of his time in administrative duties, and the importance of his scientific studies has undoubtedly influenced him in his decision to retire, for only by retiring from active administrative work could he devote himself uninterruptedly to the studies that have



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FREDERICK TRUBEE DAVISON

Recently elected to the presidency of the American Museum of Natural History, a position to which he comes after having served for ten years as a Trustee of the Museum. For eleven years Mr. Davison has been in political life, and becomes President of the American Museum after having served as Assistant Secretary of War since 1926

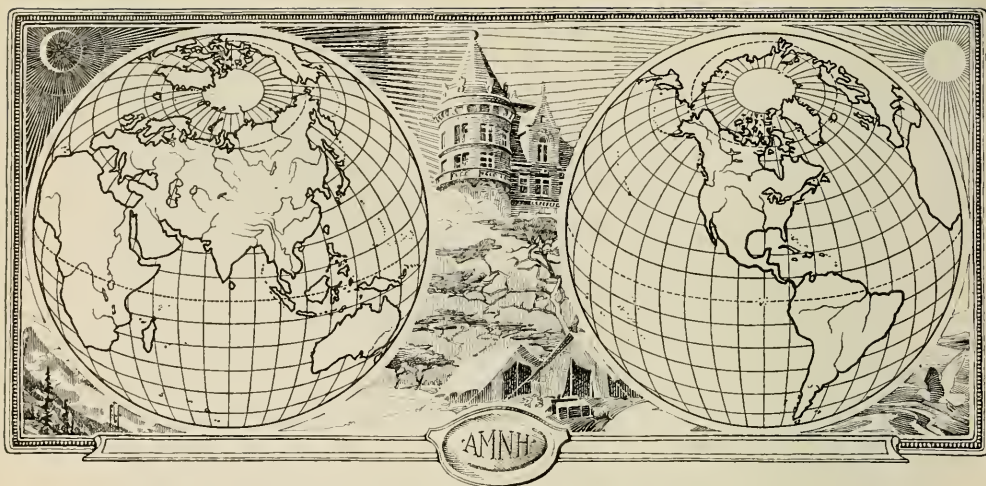
PRESIDENTS OF THE AMERICAN MUSEUM

covered so many years and which he now plans to bring to completion.

Mr. Davison, as the new president of the American Museum, does not fill his post as a newcomer, for he has served for ten years as a member of the Board of Trustees, a position that his father occupied before him. For eleven years he has been in political life, having been elected a member of the New York State Assembly in 1922 and having been ap-

pointed Assistant Secretary of War in 1926, a position that he has occupied ever since.

President Davison was installed in his new office at a meeting of the entire personnel of the Museum, held in the Museum Auditorium at ten o'clock Tuesday morning, January 10, 1933. He will devote his entire time to his new task after March 4th, when he retires as Assistant Secretary of War.



SCIENCE IN FIELD AND LABORATORY

American Museum Activities—Conservation—Meetings of Societies
Other Museums—New Publications

EDITED BY A. KATHERINE BERGER

ASTRONOMY

THE exhibition of material relating to the total solar eclipse of August 31, 1932, was held in Education Hall in the American Museum of Natural History from December 19 to January 8, and attracted much favorable comment and interest. The exhibit, held during the Christmas holidays, was viewed by an unusually large number of college and university students, and by visiting astronomers and scientists. Among the interesting things presented were the various series of paintings showing the progressive phases of the eclipse, and the unusually beautiful transparencies sent for the exhibit by the United States Naval Observatory and the Observatory of the University of Michigan. The Naval Observatory has graciously presented to the Museum the five transparencies of the eclipse taken by the Naval Observatory Expedition. These are perhaps the most beautiful and detailed photographs taken by any expedition of the corona and the prominences. These transparencies are to be on view permanently in the Astronomy Hall of the Museum. The University of Michigan photographs include most interesting ones of the flash spectrum and the interferometer plate, which will be temporarily on view in the Astronomy Hall.

THE time of the astronomical talks given by the Amateur Astronomers Association over Station WOR has been changed to 5:00 o'clock on Saturday afternoons, running for a full fifteen minutes to 5:15. Information about these talks appears in the daily newspapers.

ON December 12 Dr. Clyde Fisher talked over Station WEAF on "Youth and the Stars," and has received to date more than five hundred letters in reply to this talk. This indicates an apparently ever-increasing interest in the subject of astronomy.

THE meetings of the Amateur Astronomers Association continue to be held on the first and third Wednesdays of each month at 8:15 P.M., in the large auditorium of the American Museum. All those interested are cordially urged to attend these meetings. Following is the list of spring lectures:

- MARCH 1—"A Biologist Looks at the Stars," by Dr. R. E. Lee, Director, Department of Applied Research, Standard Brands, Inc.
- MARCH 15—"The Story of the Planets," by Mr. Oliver P. Medsger, member of the Executive Council AAA, and well-known naturalist.
- APRIL 5—"Correlation of Astronomical and Radio Phenomena," by Mr. Joseph L. Richey, Chief Technical Operator, Long Lines Dept., American Telephone and Telegraph Company.
- APRIL 19—"Cosmic Dust," by Mr. James Henry Searr, Principal Meteorologist, United States Weather Bureau.

BIRDS

CONGO FOREST BIRD GROUP.—There has recently been opened on the second floor of the American Museum the sixth of a series of twelve faunal groups of birds of the world. The new group depicts the colorful bird life of the Congo Forest, with Lukolela on the Congo

River as the locality, and represents the efforts of seven months of field work on the part of Dr. James P. Chapin, associate curator of birds of the eastern hemisphere at the American Museum. Doctor Chapin, accompanied by Franklin Edson 3d, began this work in August, 1930. The expedition was made possible through the generosity of the late Mrs. Dwight Arven Jones.

Forty-eight kinds of birds are in the group and several additional ones are painted on the background. Some of the birds included are blue-spotted guinea-fowls, several kinds of doves, two species of plantain-eaters, several hornbills, several barbets and woodpeckers, a bee-eater, a pitta, a broadbill, several bulbuls, flycatchers, starlings, sunbirds, and weaver birds. A particularly beautiful specimen is an emerald cuckoo.

The enchanting vista showing a portion of the Congo River which forms the background of the group was painted by Francis L. Jaques.

CONSERVATION

NEW DEVELOPMENTS IN THE PARC NATIONAL ALBERT, KIVU, BELGIAN CONGO.—The International Commission du Parc National Albert has held two meetings recently in Brussels, in October and December, 1932, both presided over by the newly elected president H. R. H. Prince Leopold, Duke of Brabant. At the first meeting were Mm. P. Charles, Deleque du Ministre des Colonies, Pelseeneer, Bouillenne, Schoep, Lameere, Schou-

ten, Van Straelen, De Wildeman, Maury, Willems, Marchal, le Baron de Cartier de Marchienne, Dr. P. G. van Tienhoven, members of the Commission and Dr. J. M. Derscheid, secretary of the Commission. Those unable to attend and sending regrets were Count Grey of Fallodon, Count Onslow, Prof. L. Mangin, Prof. E. Lönnberg, Dr. John C. Merriam, Prof. Henry Fairfield Osborn, Prof. E. Leplae, and the Chevalier G. van Havre. M. W. Robyns was appointed to succeed Chanoine Salée, deceased.

The opening address was made by H. R. H. Prince Leopold, who spoke of the visit of His Majesty, King Albert, to the Parc in March and April, 1932, at which time he visited the high gorilla forest on the shoulders of Mts. Mikeño and Karisimbi and the tomb of Carl Akeley. Important items of discussion were the question of measures for the protection of animals of the Parc from infectious disease, and the desirability of extending the limits of the reserve. M. Van Straelen, vice-president of the Commission, reported that since the first measures of conservation undertaken in 1923 the sanitary conditions of the Parc fauna had been generally satisfactory and the number of animals about stationary. However, anxiety has recently been caused by an outbreak of epizooty, which seems to have had its origin in British territory bordering the Eastern Belgian Congo, and which caused in 1932 considerable mortality among the buffalo and wart-hogs of the Parc. The antelopes do not



BIRD LIFE OF THE CONGO FOREST

The latest of the new faunal groups of birds of the world is now on exhibition in the bird hall on the second floor of the American Museum. A bit of Lukolela on the Congo River with its colorful bird life is reproduced in this group

seem to be affected. To prevent the spread of the disease, a sanitary cordon has been established to keep animals of the infected sectors from straying to other areas, and veterinaries have been employed to vaccinate the domestic cattle of adjacent regions. Baron de Cartier, Belgian ambassador at London and former Belgian ambassador at Washington, cited authorities to show that wild animals in their natural environment enjoy a certain immunity from disease, and that infection frequently comes from domesticated cattle. He strongly urged that the limits of the Parc be extended as far as possible as a barrier against the infiltration of the communicable diseases from domestic animals, and in order to permit the scientific observation of pathological cases resulting from contagious diseases in natural surroundings, M. Charles, Administrateur General of the Colonies, suggested that it would be advantageous to establish along the border of certain sections of the Parc "neutral zones" several miles in width to prevent animals from straying from either side, and Doctor Derscheid advised that steps be taken immediately to establish such a zone with a protecting hedge, in the Kibumba region.

In the December meeting of the Commission, a complete program for dealing with communicable disease as well as plans for the furtherance of scientific research were dealt with. These details will be given in the next issue of *NATURAL HISTORY*.

All the members of the Commission present expressed to H. R. H. Prince Leopold the deep gratitude of the Commission and of the scientific world for the active interest which the Belgian royal family has taken in the advancement of science and the protection of nature.

—MARY L. JOBE AKELEY.

EDUCATION

BIRD WALKS.—On Tuesday, April 4, Mrs. Gladys Gordon Fry, known to bird lovers and students as "The Bird Lady," will open her spring series of bird and tree walks in Central Park, under the auspices of the American Museum of Natural History.

Central Park is one of the best places in the country to see migratory birds, and New Yorkers have an opportunity that many suburbanites do not have of seeing many different species in a restricted area.

An early morning group will meet at six-thirty o'clock on Tuesdays and Fridays, beginning April 4. There will also be a nine-thirty o'clock group on these days. Each class period will be one and one half hours in length. The fee for the course of ten lessons will be \$12.

At three o'clock on Tuesdays and Fridays, a children's group will meet. The length of these class periods will be determined by the age of the children registering. The fee for this course of ten bird walks will be \$10.

The rendezvous for all groups will be in front



THE NILGIRI LANGUR GROUP

Langurs possess great powers of leaping, and are among the most active of monkeys. When resting, they allow their tails, which only rarely aid in balancing, to hang limply downward like plumb-lines. From the American Museum group



THE PROBOSCIS MONKEY

Proboscis monkeys, found only in Borneo, are confined to the mangrove and Nipa palm forests bordering brackish tidal rivers and estuaries, across which, it is said, they swim freely. From the American Museum group

of the main entrance to the Museum, on Seventy-seventh Street. Applications may be made to the Department of Education, Room 306, School Service Building, American Museum of Natural History, or by telephoning ENdicott 2-8500, Extension 181.

MAMMALS

PROGRESS IN THE HALL OF PRIMATES.—Two habitat groups with backgrounds and accessories have recently been completed in the Hall of Primates of the American Museum. The species represented are the proboscis monkey of Borneo and the Nilgiri langur of southwestern India.

The central section, or the habitat group pavilion, of the Hall of Primates has been closed to the public for many months while these groups were being constructed. All of the spaces in the habitat section are now occupied and the pavilion will be opened to the public at an early date this spring.

The opening of the habitat groups has necessitated a partial rearrangement of exhibits in the hall, since large cases which have been closing the east and west approach to the groups had to be shifted in order to afford easy access to this part of the hall. At the same time, several of the older type of cases have been dismantled and the space taken over for a better display of primate material, with the result that the visitor will notice a marked change in this hall.

In addition to the apes and monkeys on display, a collection of dogs and cats has temporary

quarters in the hall until the final plan for an alcove of domestic animals has been consummated. The collection of dogs has been rearranged under this plan of revising the Hall of Primates.

Not only has the shifting of cases in the hall resulted in removal of very obvious congestion and the creation of unobstructed avenues of circulation, but the re-arrangement of specimens has permitted a better development of the exhibits, and the visitor will discover much in this hall to hold his interest.

In several other mammal halls work has been started to remove congestion and to rearrange old exhibits with a view to emphasizing some aspects not heretofore stressed, and it is possible to carry out rather important changes of this character without incurring any large items of expense for new construction. As these changes are completed, the details will be set forth in the columns of NATURAL HISTORY.—H. E. ANTHONY.

OF especial interest in the mammal collections of the American Museum is a gray seal (*Halichoerus grypus*), captured at Atlantic City, New Jersey. This constitutes the southernmost record for this seal on the American coast. The range of the gray seal is not very definitely known, but it is undoubtedly confined to the North Atlantic and, on the American coast, normally does not occur south of Nova Scotia. According to Mr. C. A. Hill, manager of Young's Million Dollar Pier, this specimen was caught in

the nets on the pier in March, 1931, following a severe northeast storm, and was exhibited on the pier during that summer and afterwards sent to the New York Aquarium for the winter. The following spring it died and is now preserved in the American Museum of Natural History. This specimen, a young male, measured five feet, seven and a quarter inches. From Millais' account of the gray seal, it must have been from two to three years old, maturity not being reached until about five years, when large males measure as much as nine feet from nose to tip of tail.

The gray seal appears to be one of the rarest of the American true seals. It frequents the rough and troubled waters of rocky outlying islands, where the sea is deep and seldom still. It spends much of its time in the water. Most adults leave their homes after the breeding season to spend the winter at sea and are sometimes seen at a considerable distance from land. The gray seal is probably the only true seal that bears its young in the fall.—G. G. G.

EXPERIMENTAL BIOLOGY

DOCTOR YAICHIRO OKADA, professor of zoology at the University of Tokyo, Science

and Arts, is visiting the American Museum as a guest in the laboratory of experimental biology. Doctor Okada is carrying forward investigations on color and color patterns.

THE United Clay Mines has placed a house in the village of Crossley, New Jersey, at the disposal of the laboratory of experimental biology of the American Museum. Crossley is situated at the heart of the Pine Barrens, and the house will be used as the center for supplementing laboratory work on the biology of reptiles with observations in the field.

REPTILES AND AMPHIBIANS

MR. CLIFFORD H. POPE, assistant curator of herpetology, has returned from abroad, where he has been studying the Asiatic reptiles and amphibians in the principal museums of England and the Continent. His investigations will be published in the reptile volume of the reports of the Central Asiatic Expeditions.

MR. K. P. SCHMIDT, former assistant curator of reptiles in the American Museum and now in charge of the reptile work in the Field Museum, recently returned to the Museum to investigate its collection of coral snakes. Mr. Schmidt is monographing the group and has examined material in all the principal museums abroad.

MEETINGS OF SOCIETIES

ANNUAL MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—Twelve departments of the American Museum of Natural History were represented in the Museum's booth in the general exhibition at the Atlantic City meeting of the American Association for the Advancement of Science, held from December 27 to 31, 1932. The space allotted to the American Museum was ten feet wide and forty feet long. It was located in a prominent section of the Ballroom of the Atlantic City Municipal Auditorium.

The exhibits were open to the numerous members of the American Association and, on occasion, to the general public as well. In the opinion of Dr. F. C. Brown, director of the Exhibition, the American Museum's booth, due to its central position at the rear of the Assembly section, was viewed by practically everyone who entered the Exhibition Hall and who attended the group lectures. The



A CORNER OF THE AMERICAN MUSEUM EXHIBIT
Original cover paintings for NATURAL HISTORY Magazine embellished the booth where membership literature and information were disseminated at the Atlantic City meetings



THE AMERICAN MUSEUM BOOTH AT ATLANTIC CITY

Considerable interest was shown by visiting scientists in the exhibits of various departments of the American Museum, at the annual meeting of the American Association for the Advancement of Science, December 27-31, 1933

representatives of the Museum in immediate charge of the booth distributed literature and information about the Museum and its varied activities, to all inquirers. Many of the country's outstanding scientists visited the space and expressed their interest in the materials displayed.

Mr. Harold E. Anthony showed the skin of a gray seal captured at Atlantic City and Mr. Albert E. Brand provided phonograph records of bird voices. These records were played constantly and excited much interest. Mr. Barnum Brown exhibited a dinosaur fossil showing pelvic plates, Mr. William H. Carr displayed a relief model of the Bear Mountain Trailside Museum area, Mr. James L. Clark's bronze statue of the Marco Polo Sheep was shown in the membership booth. Mr. Hawthorne Daniel provided original *NATURAL HISTORY* cover paintings and a magazine display. Mr. Charles J. Lang exhibited his model of *Stegosaurus*; Dr. Frank E. Lutz demonstrated the biological principles of ultra violet patterns in butterflies; Dr. Roy W. Miner and Mr. Herman Müller showed five glass models of rotifers; Mr. John T. Nichols displayed several fish specimens, including a model of a Chinese sucker; Dr. G. Kingsley Noble demonstrated two biologic principles in connection with reptiles and amphibians; Mr. Harry C. Raven showed casts of the sole muscles of human and mammal feet; Dr. Chester A. Reeds provided a meteorite exhibit with real and supposed meteorites; Dr. George C. Vaillant displayed archaeological material from the Valley of Mexico; Mr. Herbert P. Whitlock showed charts and specimens to demonstrate his teaching methods in the Hall of Minerals.

THE AMERICAN ASSOCIATION OF MUSEUMS will hold its annual meeting on June 12 to 14, with headquarters at Chicago, Illinois.

ANNUAL DINNER OF THE EXPLORERS' CLUB. On January 28 more than 300 members of the Explorers' Club met for its annual dinner. Sir Hubert Wilkins spoke of the plans of the Ellsworth transantarctic flight, saying that it will be "the last big geographical discovery it is possible to make." This trip is scheduled to take place next winter.

Other speakers at the dinner included Dr. William Beebe, H. E. Anthony, Capt. Bob Bartlett, Prentiss Gray, William J. Morden, Harry C. Raven, Carl von Hoffman, and Roy Chapman Andrews, president of the Club.

INSECTS

ACCORDING to plans, Frank E. Lutz and Herbert F. Schwarz of the department of entomology of the American Museum and Mr. E. I. Huntington as a volunteer assistant are at the Barro Colorado Laboratory in Gatun Lake, Canal Zone, continuing their study of Panamanian insects.

MARINE LIFE

PROGRESS ON THE CORAL REEF GROUP.—Curator Roy W. Miner and Mr. Chris E. Olsen left for the Bahama Islands on February 24 to make undersea observations on the coral reefs of Rose Island and Andros Island in connection with the completion of the coral reef group in the hall of ocean life. They expect to spend about six weeks in the field, re-



A "ROUND TABLE" TALK IN THE MORGAN HALL OF MINERALS AND GEMS

The group is seated around the table on which the illustrative matter, consisting of large photographs, charts, and drawings, is placed, and from which, at intervals, specimens are passed around to the group. Note the ease and freedom with which such a group may be addressed

turning early in April. The expedition is to be joined by Mr. and Mrs. Roswell Miller and Mr. E. S. Tootle in Nassau, where boats will be at their disposal. Diving helmets and undersea cameras will be utilized to secure photographs and motion pictures.

MINERALS AND GEMS

SINCE the publication of the note in the preceding issue of *NATURAL HISTORY* regarding its "Round Table Talks," the department of minerals and gems of the American Museum has prepared an exhibit illustrating this method of handling groups of from fifteen to thirty, for the meeting of the American Association for the Advancement of Science at Atlantic City. The exhibit featured the round table talk on "Jade" delivered on November 29, 1932, to a group representing several Women's Clubs of Northern New Jersey. The accompanying photograph shows this group on the occasion of its visit to the Museum.

The Curator will again give in April and May the series of four informal talks on "Appreciation of Gems," which was well attended last fall.

These free lectures are scheduled for Saturday afternoons at 4 P.M. in Room 202 of the School Service Building.

The dates and subjects are as follows:

APRIL 22, "The Antique Use of Gems."

" 29, "Jade, Its Carving, Mythology and Symbolism."

MAY 6, "Famous Gems of History"

" 13, "Legends of the Gems," a reading from Hindu folk tales

SCIENCE OF MAN

FRESH discoveries at Monte Alban have been announced at Monte Alban, Oaxaca, Mexico, where Prof. Alfonso Caso, the leader of the joint expedition of the Ministry of Public Education and the National University of Mexico, has been carrying on his second season of excavation.

Monte Alban may well produce the key to the archaeology of southern Mexico. The site is of the greatest strategic importance, dominating the broad plains of the Valley of Oaxaca. Historical tradition as well as the archaeological remains show two civilizations in conflict, the Zapotec who were indigenous to Oaxaca, and the Mixtec, a Nahuatl people who linguistically were allied to the Aztec in the Valley of Mexico and whose culture may possibly have been the source of the Aztec civilization. Remains in the form of stone reliefs have been found of a third, earlier group, which may be of great importance in link-

ing the archaeology of Oaxaca to that of the Maya.

These discoveries at Monte Alban should be of great interest to friends of the American Museum and readers of *NATURAL HISTORY*. Professor Caso has described his great discovery of January, 1932, in "Reading the Riddle of Ancient Jewels," an article in the September-October number of *NATURAL HISTORY*. A series of casts of the magnificent bone carving found in the tomb has been recently installed in the Mexican Hall as part of a synoptic collection, illustrating this important discovery. In the November-December issue Doctor Vaillant's description of a new acquisition, "The Jade Tiger," shows the important bearing of the early stone reliefs on the archaeology of Mexico, as being clues to a new racial group.

Furthermore, the pioneer work on the archaeology of Mexico was carried out by the American Museum under the able direction of Prof. M. H. Saville during the winters of 1898-1902. These collections are on exhibition in the Mexican Hall and preparations are being made to publish the final results of his explorations in the *Anthropological Papers* of the Museum.

For the last five years the Museum has been working in close coöperation with the archaeologists of the Mexican Government on the prehistory of the Valley of Mexico. It is, therefore, a source of great satisfaction that the Museum is able to give so clear a picture of this aspect of the distinguished work the Mexicans have been doing in elucidating the archaeology of their country, as well as to have a share in the research.

FRANK WOOD

FRANK Wood, curator of the Old Dartmouth Historical Society (Whaling Museum), of New Bedford, died on January 3, 1933, rich in years and the affection of his friends. Since 1915 the guiding spirit of one of the most interesting of all museums, Mr. Wood was also affiliated with the American Museum of Natural History as an associate member, and as the close colleague of several of our staff interested in marine and ethnographic subjects.

Born of an old New Bedford family on May 24, 1851, Mr. Wood became steeped in the lore of whaling and voyaging. When twenty-five, he shipped on the "Cleopatra" from New York to Yokohama. He later made the passage by clipper ship 'round the Horn to San Francisco, subsequently taking charge of a pioneer trading post in the mining district of Nevada.

For several decades thereafter, Mr. Wood was engaged in textile brokerage in various cities,

frequently interrupting his occupation by lengthy travels. Making his final home in New Bedford in 1900, he married first Miss Annie Seabury, of that city and, several years after her death, Mrs. Jane G. Campbell, of Utica, who survives him.

Once back among the scenes of his birthplace, Mr. Wood gave free rein to his avocational interests, and his office on Hamilton Street soon came to resemble a maritime museum far more than the staid headquarters of a cotton broker. In this fascinating setting he offered sound advice during the outfitting of the American Museum's South Georgia Expedition, in the brig "Daisy," early in 1912.

In 1915 he accepted, at a nominal salary, a post which was ideal both for himself and his institution, namely, the curatorship of the Whaling Museum. Here he did much to preserve the glorious whaling tradition of New Bedford during a manufacturing age which was for long indifferent if not actually hostile to it. Besides transferring his own collections to the Museum, Mr. Wood had the magnetic faculty of pulling treasure painlessly out of others. Wanting nothing for himself, he made innumerable visitors rejoice in the privilege of giving their appropriate heirlooms to one of the best of repositories.

The rare sixth sense, which intuitively recognizes the genuine and the significant in human artifacts, was phenomenally developed in Mr. Wood. Whether dealing with whalemens' scrimshaw, Inca weaving, or African woodcarving, his taste and judgment seemed infallible. His opinion was constantly asked by men with greater technical knowledge than his own. Indeed, making no claim to scholarship himself, he was continually sought out by scholars, which is the best measure of his calibre.

On the personal side, Mr. Wood was singularly winning. In the happiest sense he was always a boy. As long as his last intimate survives, he will be remembered in the perfect setting of a Colonial dining room on Pleasant Street, or in the far-away *ambiance* of his little Japanese garden.—R. C. M.

WILLIAM J. HOLLAND

ON December 13 last, Dr. William Jacob Holland, director emeritus of the Carnegie Museum, died at his home in Pittsburgh, as the result of a stroke suffered by him on November 28. His death brings to a close a life which during its span of 84 years was privileged to develop along lines of unusual richness and variety.

Doctor Holland was born in Bethany, near Mandeville, Jamaica, the son of Moravian mis-

sionaries from Salem, North Carolina. Both his parents and grandparents were deeply interested in natural history, and from earliest childhood he was taught the scientific names of plants and shells before he knew their common names. His interest in birds and insects strengthened as he grew older, and he collected everything he could lay hands on. It was not, however, until after he had become settled in the pastorate of a church in Pittsburgh that he resolved to master the subject of entomology. He acquired practically all the literature relating to lepidoptera in whatever language written and he employed men to collect for him, not only in the United States but in many foreign countries. He himself collected everywhere he went, and he bought many classical collections, among these the great collections of Wm. H. Edwards upon which was founded Edwards' work in three volumes on the butterflies of North America.

Doctor Holland devoted a great deal of time to physics and astronomy, and was personally acquainted with most of the leading astronomers and physicists. For twenty-five years he was a student of palæontology, and at Mr. Carnegie's request undertook the development of the great museum which bears his name. Carnegie urged him to lay stress upon palæontology and stood ready to furnish all the needed funds. The result has been the discovery of a vast quantity of wonderful material in the fossil quarries of our western country, among them complete skeletons of a number of huge dinosaurs.

Doctor Holland became director of the Carnegie Institute of Pittsburgh in 1893. In 1922 he was made director emeritus, and served in this capacity until his death. In addition to *The Butterfly Book*, Doctor Holland also wrote *The Moth Book*, *To the River Plate and Back*, *The Insect Guide*, and many scientific papers published by the United States Government and the Zoological Society of London.

OCEANOGRAPHIC EXHIBIT

ON the evening of January 27, the New York Zoological Society in coöperation with the American Museum of Natural History opened an exhibit of deep-sea fishes and the apparatus of the Bermuda Oceanographic Expeditions, including the bathysphere in which Dr. William Beebe and Otis Barton descended to a depth of 2200 feet in the ocean. Doctor Beebe first gave a brief illustrated lecture, following which the audience numbering 1500 people passed into Education Hall of the Museum to view the exhibit. Great amazement was expressed by the spectators that two men had been able to descend into the ocean

in this small, blue sphere with its fused quartz windows, crystal clear, which have withstood pressures of twenty tons. Prof. Auguste Piccard was a fascinated visitor and examined the bathysphere with great care.

THE VISIT OF AUGUSTE PICCARD

DURING his recent visit to New York City, Prof. Auguste Piccard, Swiss scientist, and professor of physics in the University of Brussels, lectured at the Town Hall under the auspices of the Civic Forum, on his two flights into the stratosphere. He was introduced by Prof. Henry Fairfield Osborn, who gave a brief resumé of Professor Piccard's activities in connection with his studies of these rays.

Professor Piccard's primary object in making these ascents, said Professor Osborn, was to gain information as to the behavior of the cosmic rays at great heights and thus get at the vast untrapped energy within the atom. The early observations from mountain tops and from records made by instruments carried aloft by unmanned balloons seemed to indicate that the cosmic rays increase in intensity with altitude. A few days previous to Professor Piccard's second record-breaking ascent, however, Professor Erich Regner of the Stuttgart Institute of Technology, announced after sending up an unmanned sounding balloon with automatic instruments to a height of seventeen miles that the cosmic rays do not increase in intensity with altitude at the rate deduced from previous observations. Professor Osborn said that this raises the question: Are these so-called cosmic rays of terrestrial or cosmic origin? He invited Professor Piccard to discuss this, as well as what advantage his proposed ascent near the Magnetic Pole in North America will give to this study.

ON January 29 Professor Piccard was entertained at a luncheon on the occasion of his 49th birthday by a number of well-known scientists and explorers at the Hotel St. Moritz. Among those who paid tribute to Professor Piccard's attainments were Dr. William Beebe, Dr. James H. Kimball, and Dr. Roy Chapman Andrews.

OTHER MUSEUMS

THE Buffalo Museum of Science announces that July 5-August 24, 1933, will mark the sixth season of the Allegany School of Natural History—"The School in the Forest" in Allegany State Park, New York.

Founded under particularly favorable natural conditions in especially suitable location and surroundings, the Allegany School of Natural

History has developed into one of the finest summer schools in the country for studies in botany, zoology, and geology with emphasis on the natural history aspects.

In this "School in the Forest" the State of New York has an almost ideal institution for those who want to extend their laboratory and book training in the out-of-door world. In addition the School appeals to camp and outdoor leaders of various kinds and to those interested in the nature work of museums and parks and forests.

Each class is with an instructor for a full day each week and for a conference hour later in the week. In addition each student works out of class independently or with occasional direction for nearly two days. The courses offered are Field Zoology, Field Geology, Field Botany, Natural History of Birds, and Nature Study.

The small classes and the plan of the schedule make it possible for the faculty to continue actively in research, thus contributing to scientific knowledge as well as to a lively, stimulating, intellectual atmosphere in the community while they are closely and regularly associated with every member of the class.

Several nature study features include the open-air museum, the Nature Trail, the Indian Garden, the Water Garden, and the Fernery. Elsewhere in the Park are hiking trails, swimming pools, bridle paths, baseball diamonds, tennis courts, and a 120-acre lake with boating.

The Allegany School of Natural History is conducted by the Buffalo Society of Natural Sciences in cooperation with the New York State Museum and affiliated with the University of Buffalo. Registration should be made through the Buffalo Museum of Science, Buffalo, New York; the New York State Museum, Albany, New York; or the University of Buffalo, Buffalo, New York.

THE LIBRARY

AGAIN the Library is indebted to Japan for two of its recent noteworthy accessions.

Iconographia Insectorum Japonicorum is a most important contribution to Japanese entomological literature, in the preparation of which twenty-six different outstanding Japanese specialists had a share. Although written in Japanese, it has a Latin index and Latin captions for the illustrations. It is a work which, by its completeness and exactness, will prove a tool of inestimable value to all workers in this field. It was issued by Hokuryukan in Tokyo, 1932.

The Library is also most fortunate in receiving as a gift from Mr. E. Sunamoto of Osaka, Japan,

the second and closing volume of his monograph on *The Elephant*. The complete work, with its 2169 pages, 311 illustrations, its excellent English bibliography on the "elephant, ivory, ivories and allied subjects" is a valuable and comprehensive contribution for which sincere thanks are due to Mr. Sunamoto.

The Maya Society at the Johns Hopkins University, by its publication of the William Gates reproduction of *The Dresden Codex*, has taken another noteworthy step in making possible the study of the Mayan codices as connected language texts. The edition has been divided into eight chapters and the pages have been mounted on one side only, so that each chapter can be easily spread out under the reader's eye.

At the same time another interesting addition has been made to the Library's collection of Mexican codices by a transfer from the department of anthropology. It consists of fragments of more than a score of original documents that were secured at an old monastery church of Santo Domingo in Tlaquiltenango, State of Morelos, Mexico. Around the colonnade of this church, which was completed in 1540, cut up manuscripts in the native style of writing, as well as Spanish records, were pasted, face down, in a band or frieze. Later, having become weather-worn, they were overlaid, and incidentally protected, by several layers of plaster. They were discovered by accident a number of years ago, and presented to the Museum.

DURING December and January the following *Bulletins* and *Novitates* have been published by the American Museum:

BULLETIN

- Vol. LXV Complete. The Birds of the Belgian Congo Part I. By James P. Chapin.
Vol. LXIII Art. 5. Burt, Charles E. and Mary Danheim Burt.—Herpetological Results of the Whitney South Sea Expedition. VI. Pacific Island Amphibians and Reptiles in the Collection of the American Museum of Natural History.

NOVITATES

- No. 587. Simpson, George Gaylord.—Mounted Skeletons of *Eohippus*, *Merychippus* and *Hesperosiren*.
No. 588. Lipman, Charles B.—Are There Living Bacteria in Stony Meteorites?
No. 589. Lipman, Charles B.—Discovery of Combined Nitrogen in Stony Meteorites (Aerolites).
No. 590. Mayr, Ernst.—Birds Collected During the Whitney South Sea Expedition. XXII. Three New Genera from Polynesia and Melanesia.
No. 591. LaMonte, Francesca.—A New Subgenus of *Plecostomus* from Brazil.
No. 592. Myers, George S.—*Pachypanchar*, a New Genus of *Cyprinodont* Fishes from the Seychelles Islands and Madagascar.
No. 593. Gertsch, W. J.—Notes on American Spiders of the Family *Thomisidae*.
No. 594. Hatt, Robert T.—An Annotated Catalogue of the Hymenoptera in the American Museum of Natural History, with a Description of a New Species from the Lower Congo.
No. 595. Cockerell, T. D. A.—Rocky Mountain Bees.—IV.

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NEW PUBLICATIONS

Nature by Night. By Arthur R. Thompson, 118 photographs, 144 pages (265 pages in all), large $9\frac{1}{2} \times 7\frac{1}{2}$, index, published by Robert O. Ballou, New York, 1933.

WHEN shadows lengthen and merge in the English countryside, Mr. Arthur R. Thompson sets forth with note book and camera to visit the haunts of the stolid badger, the excitable mice, the large and small owls, and other creatures of the night. He has discovered that twilight and darkness are hours of intimate revelation in the out-of-doors. Not always does he go far afield for, as he says—"the life of the night is everywhere; the hedgerows, fields and woodlands teem with it, the moors and seashores are never silent. The night is a world of its own, a world apart from man. He can really never enter it; can follow, but only for a little way."

Mr. Thompson is a naturalist who enjoys sharing actual adventures with others, in a friendly way. His work is well planned and, consequently, well-balanced. Never is he pedantic or dogmatic. He has a straightforward, unpretentious, and honest style. The chapters on the mole, hedgehog, fox, and badger are particularly interesting and worthwhile. Here direct field observations are faithfully reported as a running narrative that is never boring or, on the other hand, "flighty." The author is by no means a sentimentalist, yet commands a poetic sense of expression that is always aptly used. The results of his careful studies in ecology are frequently apparent and also enrich the book.

The author often exhibits rightful indignation at various attempts on man's part to upset the "balance of nature." He is an ardent conservationist of an intelligent sort. His indictment of the American gray squirrel's introduction into England is accomplished in no uncertain terms. He says that, "if the gray squirrel is not taken in hand quickly, and greatly reduced in numbers (preferably exterminated), the red squirrel ("true English species") will probably entirely disappear from our oak and beechwoods." ". . . In any case, we now have our own red squirrel and I have met nobody who would willingly exchange it for the gray alien." We can sympathize with the author's viewpoint when we consider the English sparrow's conquest of America!

It is by no means difficult to understand why

this delightful book has experienced four printings, in as many months, in England. In format and excellence of illustration the large volume presents an appearance that causes one to wonder why other publishers, both English and American, have not produced nature books of similar attractiveness and permanency of value. The night photographs are of unusual beauty and interest and lose little by their excellent reproduction.—W. H. CARR.

Economic Mammalogy. By Junius Henderson and Elberta L. Craig, 397 pages. Charles C. Thomas, Springfield and Baltimore.

WITH the world scrutinizing every source of revenue and every cause of expense it is a propitious moment for the appearance of the first book dealing with all phases of the newly recognized field of scientific investigation, *Economic Mammalogy*. Information concerning the relation of mammals to man and other species in the world has long been accumulating, as evidenced by the oldest volume quoted in this book—the Bible. In recent years there has been a great growth of scattered studies on the fauna, which, coupled with altered relations due to changes in our civilization, have necessitated a broad review of the whole subject such as these authors have undertaken. The task meant the digestion and condensation of matter printed under some 800 titles into 347 pages. Despite the enormous scope of the field covered, the subject is well handled and nothing is overlooked, from the value of the domestic animals to the æsthetic importance of the small wild creatures.

The first section of the book treats of the general considerations, such as the fur, leather and hide trades, mammals and the hunter, mammals as disease carriers, the relation of mammals to soil turnover, fire hazards and history. The second section outlines the major economic interests of each of the larger groups of animals.

If the book has a fault, it is brevity, for if the subject had been given five volumes the size of the present one the field could hardly have been completely covered. The use of pictures and other illustrative material would have given the book wider public interest, perhaps in the field in which the need is greatest, but in its present form it stands a fine, well-balanced handbook

valuable to any naturalist, administrator of wild life, or educator. Anyone perusing its pages would soon abandon any opinion regarding the status of any species as a pure blessing or a complete menace, for the authors do not propound a doctrine but record facts.—R. T. H.

Medical Entomology. By Robert Matheson. Charles C. Thomas, Springfield, Ill.

IN this work Doctor Matheson has produced an up-to-date compilation of the knowledge of insects in relation to human welfare, the result being an indispensable textbook on this subject of ever increasing importance. The book is beautifully printed and illustrated with more than two hundred excellent figures, a feature adding greatly to its value.

It is obvious that this work is suited primarily for students of medical entomology but its usefulness extends far beyond this limited field. The medical practitioner will find in it a store of information on a subject of which he may have only a smattering of knowledge and the layman may find in it entire chapters of interesting and instructive reading. For a book of its kind it contains an unusual amount of the latter, a feature which must not be overlooked in any consideration of its merits and one which is too often missing in a text book.

In addition to the insects Doctor Matheson devotes three chapters to other Arthropods—spiders, scorpions, mites, etc. Of the insects there are: one chapter on bugs, one on lice, ten on flies, one on fleas, and one on poisonous or urticating arthropods, with a final chapter on the collection, preservation, and mounting of insects. The classification of the various groups is covered sufficiently for the intended purpose of the work, followed by a thorough discussion of the various forms transmitting disease, the characteristics of the disease organism, treatment, etc. and a complete bibliography.

The historical review of *Medical Entomology* contains much of a romantic nature and includes a list of twenty-one scientists, martyrs to the diseases they studied that these scourges might be conquered for the benefit of the human race.

The chapter on poisonous arthropods may prove surprising to the reader, as the lethal nature of spider bites is said to have been greatly exaggerated. The bite of some spiders and the sting of some scorpions are known to be poisonous, but the danger is usually not much greater

than in the case of a bee or wasp sting. The tarantulas are shown to be less dangerous than some smaller spiders. Nevertheless, some spiders and some scorpions are extremely poisonous to man, and there are definite records of death resulting from the bites or stings. However, in the northern States no seriously poisonous species are known to occur.—C. H. CURRAN.

Australian Finches in Bush and Aviary. By Neville A. Cayley, President of the Royal Zoological Society of New South Wales. Angus & Robertson, Ltd., Sydney, 1932, 80 vol., pp. XVIII, 256, 10 Plates, many half-tones and distribution maps.

THE keen interest in birds existing at present in Australia is demonstrated by the many popular bird books that have appeared in recent years. The well-known author of the Australian book *What Bird is That?* gives in this little volume a complete survey of the Australian weaver-finches with descriptions of all the species and subspecies, notes on their distribution, and life histories.

There are no true finches found in Australia, their place being taken by the weaver-finch family, which contains such familiar and beautiful birds as the Gouldian finch, the crimson finch, and the diamond sparrow. All of these species have been kept in captivity, and most of them have even been successfully bred in captivity. The reader who is interested in aviculture will therefore greatly appreciate the extensive information which Cayley gives about the treatment, food, diseases, and the breeding of these birds. Aviculture has always contributed a great deal toward our knowledge of birds, and it is gratifying to learn how flourishing this branch of ornithology seems to be in Australia.

—ERNST MAYR.

What Butterfly Is That? A Guide to the Butterflies of Australia. By G. A. Waterhouse. Illustrated by Neville W. Cayley. Angus & Robertson, Ltd., Australia, 1932.

UNDER the main title of "What Butterfly Is That?" Doctor G. A. Waterhouse has written and Angus & Robertson, Ltd., of Sidney have published what appears to be a very complete and satisfactory manual of the butterflies of the island continent. The adults of nearly all of the Australian species are illustrated in color and there are numerous black-and-white illustrations of immature stages. The text also is full of information for the student of this part of the world's fauna.—F. E. LUTZ.

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1933

The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor



A. KATHERINE BERGER
Associate Editor

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HENRY FAIRFIELD OSBORN
From a Painting by Julian Lamar
1933

This portrait will hang in the Members' Room at the American Museum in recognition of Professor Osborn's immeasurable services to the institution

(See "*The Master Builder: Henry Fairfield Osborn*," Page 251)

VOLUME
XXXIII

NATURAL HISTORY

NUMBER
THREE

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CROPS AND CIVILIZATIONS

Cultivated Plants and the Origins of Civilizations

By ELMER D. MERRILL

Director, The New York Botanical Garden

FOREWORD.—At a recent lecture before the Members of the American Museum of Natural History Doctor Merrill presented a general discussion of the interesting series of correlations between the origins of cultivated food plants basic to civilizations and the origins of civilizations. The interest and importance of the subject, especially at this time, impelled the editors to invite Doctor Merrill to prepare the following article for the readers of *NATURAL HISTORY Magazine*

THE plants and animals of our everyday life we take for granted, seldom giving a thought as to whence they came, where they originated, when, where, and by whom they were first taken from the wild and subsequently distributed. Yet these very plants, now long cultivated, and these domestic animals form the basis of agriculture, and agriculture is the basis of all higher civilizations.

It is an evident fact that all such plants and animals were derived from the wild forms which man originally utilized as food. His association with plants is of course race-old, and at an early period in his development he differentiated between the edible and the non-edible species, and through empiricism learned intimately of those best suited to his needs. These developments took place many thousands of years before anything approaching agriculture was evolved, going back several hundred thousand years in the history of man's advance, during most of which period he merely

gathered the edible portions of wild growing plants for food.

The beginnings of agriculture long antedate recorded history. Every basic food plant now cultivated and every farm animal now utilized had already been adapted to man's needs through domestication previous to the time when the first chronicles were chiseled in stone.

Conservative anthropologists claim that the beginnings of culture approximate the close of the Tertiary, near the commencement of the so-called Ice Age. As geologic time is now estimated, this was about one million years ago. At this time man was a very primitive nomadic hunter and fisher, but even then crude stone implements were in use. Man's actual existence probably goes far back of the close of the Tertiary. For most of this period progress was slight, but beginning 20,000 to 30,000 years ago more definite advances were made. The use of fire, construction of shelters, and use of clothing and bodily ornaments were established among the more advanced peoples, as well as the art



WORLD CENTERS OF THE ORIGIN OF CULTIVATED PLANTS

The stars indicate the places of origin of basic food plants. The areas outlined by the small x's are those where cultivation commenced. After Vavilov, 1930

of sculpture, the practice of various ceremonies, and formal burial of the dead. Yet man was still essentially a nomadic hunter.

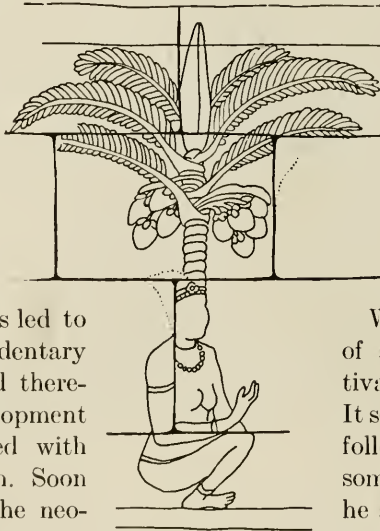
Sometime not far from 8000 to 10,000 years ago occurred an economic revolution of the greatest significance to man. This was the establishment of a permanent agriculture—the actual domestication of animals and plants. The acquisition of a dependable food supply thus led to the establishment of sedentary life, division of labor, and thereby the more rapid development of those factors concerned with what we term civilization. Soon after the beginnings of the neolithic age, perhaps 12,000 years ago, came the development of ceramics, the manufacture of tex-

tiles, the use of copper, gold, meteoric iron, and later the development of metallurgy. Concomitant with these came

marked advances in civil, political, and ecclesiastical organizations, the establishment of law and order, and the birth of architecture, eventually followed by the invention of writing and other factors too numerous to mention.

Whether the domestication of animals preceded the cultivation of plants is immaterial. It seems probable that man did follow his flocks, at least in some parts of the world, before he actually commenced tilling

the soil, but it was the actual planting of food crops that led to the establishment of perma-



OUTLINE OF A BAS RELIEF OF THE COCONUT PALM FROM THE TEMPLE OF BOROBUDUR, JAVA. AFTER BAKHUIZEN VAN DEN BRINK, *DE TROPISCHE NATUUR*, 1931

nent agriculture and provided the basis on which the higher civilizations could be developed. This agriculture, which was a thoroughly established art long before the beginnings of recorded history, was peculiarly restricted to certain definite areas in both hemispheres, wherein were found in the wild the ancestors of our principal cultivated food plants as well as the progenitors of our domesticated animals. It is significant that it was in these same limited areas that the earliest civilizations originated.

For untold centuries before agriculture was established, primitive man gathered seeds, fruits, and tubers of various wild growing plants as food, even as primitive

man today in various parts of the world follows this race-old practice. Various theories have been advanced to explain the beginnings of the cultivation of plants but it is not pertinent to this subject to discuss them here; it is probable that the beginnings were largely accidental.

Twenty to thirty thousand years seems a long period of time, yet short when compared with the 1,000,000 years passed since man commenced to travel his upward path. Advances have been sporadic and unsteady in the

2000 decades or so during which he changed from a primitive nomad to a civilized being. There were periods when forward progress halted and a retrograde action



OUTLINE OF A BAS RELIEF OF THE BETEL-NUT PALM FROM THE TEMPLE OF BOROBUDUR. AFTER BAKHUIZEN VAN DEN BRINK, *DE TROPISCHE NATUUR*, 1931



Photograph from Ewing Galloway

BAS RELIEF FROM THE TEMPLE OF BOROBUDUR
Probably Eighth Century. Showing various plants, including the mango, which is depicted in the lower panel above the second group of women

ensued. But the outcome of these ages of slow and uncertain changes may be seen when we compare the advances made in the past 100 years—or even within the present century—with those in the past 2000 years, and then compare these modern periods with the preceding 5000, or even 10,000 years. One cannot say what have been the most important factors in man's advance, but certainly few can rank with our remote ancestors' discovery and application of the fact that certain plants, given proper cultural treatment, would yield a vast and dependable food supply. Agriculture must be placed high in the list of early discoveries and inventions; its establishment marked a great economic revolution.

Lest I be accused of crediting too much to primitive man, let it be recorded that while modern man has enormously improved our cultivated plants and domesticated animals with respect to quality,

yield, resistance to diseases, and adaptability to varying climatic conditions, and also by selection and breeding has originated new and important varieties, he has *not* domesticated a single additional species basic to our food supply in addition to those selected by our prehistoric ancestors. Someone may query: What about the Concord and Catawba grapes, the cranberry, and the strawberry? These grapes were developed as cultivated plants in the United States in the last century, derived from our native wild fox grape. The cranberry was also developed as a cultivated plant from the wild native species. The cultivated strawberries were developed in the Nineteenth Century only after a Chilean species was introduced, our cultivated strawberries being hybrids, their parents being a European species, a North American species, and a Chilean one. The blueberry has been developed as a cultivated plant only with-



Photograph from Ewing Galloway

NATIVES PREPARING LAND FOR PLANTING
Rice paddies in the region of Seven Pagodas, near Madras, South India



Photograph from Ewing Galloway

HAND METHOD OF HARVESTING RICE IN JAVA

Reapers at work in a rice field. They use a short knife and cut off only about eight inches of the stalk

in the present century. None of these are basic food plants.

We thus owe a tremendous debt to the unrecorded individuals who in the remote past selected from the wild the plants and animals basic to their food supply and adapted them to their needs through cultivation and domestication. These pioneers were forgotten long before recorded history commences, for the beginnings of agriculture are lost in mythology. In the early civilizations of most if not all races, the supernatural was invoked to explain this or that basic crop, whether in ancient Egypt, Greece, or Rome, among the Chinese, or the American Indians. The corn god was an important deity among the Aztecs. In ancient Egypt it was believed that wheat was the gift of Osiris; in pagan Rome that of Ceres, and our modern word CEREAL perpetuates this ancient belief.

While certain restricted regions have

produced both the early higher civilizations and the plants and animals on which those civilizations were based, vast areas in the world have contributed little or nothing of basic importance. Thus all of North America north of Mexico, all of Australia, much of South America, Africa, Europe, and Asia have been barren fields, no matter how important these larger areas have become in modern times. In America the important centers were central and southern Mexico and certain Andean regions in South America, notably in Peru, Ecuador, and Bolivia; and in Eurasia the Mediterranean basin, Asia Minor, and restricted areas in southwestern Asia, India, and China.

In each ancient center certain definite food plants and animals were basic; thus in Mexico maize was the most important single food, while in Bolivia, Ecuador, and Peru, the potato held that place; but in both there were important



THE FIRST ILLUSTRATION OF MAIZE IN EUROPEAN LITERATURE. NOTE ITS NAME "TURKISH CORN." FROM FUCHS' KREUTERBUCH, 1543

secondary foods such as the common bean and the lima bean, with various other vegetables and fruits. In Eurasia the basic foodstuffs for the Mediterranean basin, Asia Minor, and southwestern Asia were our common cereals, wheat, barley, rye, oats, with most of our temperate zone fruits and vegetables and most of our domesticated animals. In large parts of India and China probably rice would rank as the most important single food, but other Eurasian cereals were received at an early date from Asia Minor or southwestern Asia, and such secondary ones as ragi, sorghum, coix, and others were there developed. The wild form of rice now growing naturally in India and in southern China is not very different from some cultivated varieties, and we know approximately the wild forms of wheat, barley, rye, oats and millet, and other cereals, as these occur

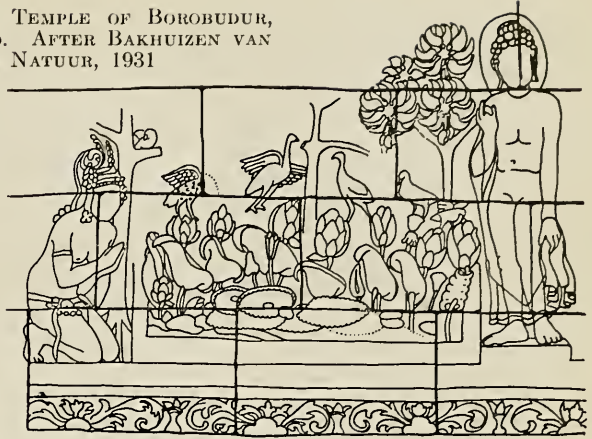
in various parts of Asia Minor and southwestern Asia.

In pre-Columbian times there was no general distribution of cultivated food plants between Eurasia and America. It is a striking fact that up to about 1500 A.D. there was not a single basic food plant nor a single domesticated animal, except the dog, common to the two hemispheres. With the period of expansion and colonization, the European peoples transmitted their economic plants and animals to their newly established colonies in America, and the native American economic plants were introduced into Europe and Asia. Following Magellan's voyage of circumnavigation in 1520, there was a very active interchange of tropical plants of economic importance between the Indo-Malaysian region and America, chiefly across the Pacific via the old Spanish



THE FIRST ILLUSTRATION OF THE PUMPKIN IN EUROPEAN LITERATURE. NOTE ITS NAME "TURKISH CUCUMBER." FROM FUCHS' KREUTERBUCH, 1543

OUTLINE OF A BAS RELIEF FROM THE TEMPLE OF BOROBUDUR,
SHOWING THE LOTUS AND THE MANGO. AFTER BAKHUIZEN VAN
DEN BRINK, DE TROPISCHE NATUUR, 1931



galleon route from Acapulco to Manila and return. The Portuguese, the Dutch and later the English also played their parts in the dissemination of such economic plants. It was not until the period of European expansion and colonization that there was any general interchange of food plants between the two hemispheres. The gourd (*Lagenaria*), some forms of which are used as food, was unquestionably common to the tropics of both hemispheres in pre-Columbian times, but it seems possible that this may have been disseminated through natural agencies. The sweet potato was apparently widely distributed in Polynesia centuries before the Europeans reached the Pacific basin; it was evidently introduced and disseminated by the Polynesians, who acquired this important food plant when they reached America during their period of expansion over the Pacific region.

This situation is one that should command the attention of all who are interested in the problems of the origins of early American civilizations. In 1882 A. de Candolle, in the closing paragraph of his classical work on the origin of cultivated plants, stated: "In the history of cultivated plants I have noticed no traces of communications between the peoples of the old and the new worlds before the discovery of America by Columbus." This was such an obvious fact that he apparently did not consider it necessary further to amplify this simple statement. His findings still hold not only in reference to this striking generalization but also to his conclusions regarding the probable original homes of the several hundred cultivated species he considered. Some conclusions regarding individual species

have been challenged by more recent authors, but in no important cases have they been successfully refuted. More recently (1931) this obvious fact has been restated by Vavilov as follows: "Agriculture in pre-Columbian America has originated quite independently of the Old World. If the peoples of the New World have come from Asia, as is supposed by the majority of the investigators, they have certainly come without the cultivated plants of Asia. The introduction of the wild plants into cultivation was a perfectly independent process in the New World."

Let us consider the American species, remembering that none of these were known in Europe or Asia until after about 1500, and we will gain some idea of the contributions of early man in America to modern agriculture. In contrast to numerous cultivated cereals in the Old World, America produced but one, though this was the highly important maize or Indian corn. Supplementary food plants include the potato, the sweet potato, cassava, lima bean, our common garden and field beans, the scarlet runner bean, tepari bean, yam bean, tomato, pepper, Jerusalem artichoke, sunflower, squash, pumpkin, fig-leaved pumpkin, musky pumpkin, peanut, chayote, papaya, avocado, pineapple, custard apple, sour-sop, cherimoya, guava, cacao, cashew,

sapote, white sapote, sapodilla, mammei, Mexican plum, and others. Particularly in South America a number of other native species were domesticated and are still there cultivated, although they are of little or no importance in other countries. They include such cultivated food plants as the ulluco (*Ullucus*), oca (*Oxalis*) anyu (*Tropaeolum*), yautia (*Xanthosoma*), arrowroot (*Maranta*), llacou (*Polymnia*), arracacha (*Arracacia*), achira (*Canna*), jataco (*Amaranthus*), quinoa (*Chenopodium*), and others. Dr. O. F. Cook estimates that in Peru alone about seventy species of native plants were domesticated and cultivated by the ancient Peruvians; not all were food plants, however, as tobacco, cotton, and some ornamental plants are included in his list. With the exception of the llama and alpaca in South America, and the turkey in Mexico, American agriculture was based on plants, and these cultivated food plants of American origin

are so diverse from those of Eurasia that for the most part they belong in genera not represented by any native species, cultivated or wild, in Europe or Asia.

Eurasia, particularly Asia, as contrasted to America, yielded a very much larger number of basic food plants as well as most of our domesticated animals, including all breeds of cattle, horses, camels, buffaloes, yaks, sheep, goats, swine, geese, hens, pigeons, and most kinds of ducks. Other than maize or Indian corn, all the true cereals originated in the Old World, including wheat, rye, barley, oats, millet, Italian millet, pearl millet, sorghum, rice, and others of minor importance such as teff, ragi, and coix. In addition to the true cereals may also be listed buckwheat, and among the vegetables the turnip, cabbage, rutabaga, rape, chard, mustard, radish, beet, parsnip, carrot, onion, leek, garlic, shallot, spinach, egg-plant, lettuce, endive, salsify, celery,



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From Ewing Galloway

AMERICAN WHEAT

Machine methods as applied to the harvesting of wheat in the state of Washington



Photograph from Ewing Galloway

PICTURESQUE AGRICULTURE

Rice and sugar cane, two of the most important food staples of the Orient, growing side by side in Java

asparagus, globe artichoke, pea, soy-bean, cow-pea, chick-pea, pigeon-pea, lentil, broad bean, hyacinth bean, asparagus bean, taro, yam, sugar cane, sesame, etc.; among the fruits the apple, pear, plum, cherry, wine grape, apricot, peach, prune, olive, fig, almond, persimmon, quince, pomegranate, jujube, melon, watermelon, cucumber, and in the more tropical regions the banana, coconut, orange, pomelo, lemon, lime, date, mango, bread-fruit, jak-fruit, rambutan, litchi, longan, mangosteen, and others. Practically all of the cultivated forage plants, including the hay grasses, clovers, and alfalfa, are of Eurasian origin. As none of these were known in America previous to the beginning of the Sixteenth Century, so none of the shorter American list were known in Eurasia until after the same date. The effective interchange of economic plants between the two hemispheres dates from the beginning of European expansion and

exploration at the close of the Fifteenth Century.

So many claims have been made, and still are being made, particularly by writers of popular articles, predicating early American civilizations on Eurasian contacts that it seems well to examine this subject from the standpoint of the origins of agriculture. There is that school that would derive all early American cultures from Eurasia as opposed to the one that considers that civilizations in pre-Columbian America were purely autochthonous. Some theorists apparently assume that in art an invention or an innovation could originate in but one place, and that from its original center the idea was disseminated by direct or indirect contacts. This school would explain apparent similarities between early advanced American civilizations and those of Eurasia, in architecture, sculpture, ornamentation, hieroglyphic writing, and in civil, political,



POTTERY FROM PERU

The "maize god" of the Peruvians (left) was buried in the field as a prayer for good crops. The body is formed of molded ears of maize. The cemetery of Cliembote on the arid coast of Peru furnished the water jar at the right, decorated with peanuts

and ecclesiastical organizations on the basis of Eurasian contacts across the Atlantic or the Pacific, or both. They cannot admit an independent development of civilization in America. While it is true that few serious students of anthropology now give credence to early Eurasian-American contacts through which culture stream Eurasian concepts and ideas dominated early American development, popular and semipopular writers give free rein to these fancies. Thus early American civilizations have been explained on the basis of contacts with the early Mesopotamians, Egyptians, Phoenicians, Greeks, Romans, the Welch, and the peoples of India, China, Japan, and Polynesia; even the "lost tribes of Israel" have been invoked. Enterprising newspaper correspondents constantly turn up evidence

for popular consumption bearing on these Eurasian-American problems and some exploring expeditions have been known to develop the field before leaving the United States, and to cultivate it after their return. We find ardent disciples of the Atlantis theory, and the extremists who support this would derive both the Mediterranean and early American cultures from this "lost" continent, supposed to have been situated in what is now the Atlantic Ocean between Europe and North America. And even more fanciful than Atlantis is the theory of the "lost" continent of Mu in the Pacific basin that permitted the Asiatic culture stream to reach America at an early date.

When Europeans colonized America they took with them the food plants and domesticated animals on which they were

dependent at home. This was true of every expanding people in Europe and Asia, and was also true in pre-Columbian America, for in America the important cultivated plants developed in more favorable climates, such as maize, beans, sweet potato, pumpkin, squash, and tobacco, were widely disseminated in cultivation far north of their original homes by the North American Indian in his crude agriculture; they all came from the more advanced peoples in the south. Aryan peoples colonizing Malaysia some 2000 years ago took with them their food and ornamental plants from India, and their Sanskrit names for these species still persist in the Malaysian and Philippine languages; the Polynesians in spreading over Polynesia took most of their food plants out of Malaysia. To the proponent of the Atlantis theory one naturally



POTATO VASE

A funeral vase in the form of two potatoes, from a grave at Chimbote, Peru. After Safford, *Journal of Heredity*



POTTERY REPRODUCTION OF SQUASH

Peruvian collections yield many examples of molded and modeled squashes, showing the special breeds developed in that region

queries: What could have been the agriculture of ancient Atlantis, that transmitted to its supposed descendants in the two hemispheres not a single basic cultivated food plant or domesticated animal in common? For if Atlantis existed and if its people had attained the high civilization its protagonists claim, it must have had a highly developed agriculture, for agriculture is basic to civilization. If Mu ever existed, why did not the cultivated food plants of Asia travel with or follow the culture stream to America quite as in more recent times—that is, some 2000 years ago—they followed or accompanied the civilizing stream out of Asia into Malaysia?

Most serious students of the problem now accept the theory that man entered America as a primitive nomad and, once here, developed an autochthonous civilization paralleling that of Eurasia but independent of it and uninfluenced by it. The agricultural and biological evidence is wholly in support of this idea. Does not the very fact that comparative philologists recognize about eighty-five families



Photograph from Ewing Galloway

A POTATO HARVEST NEAR LAKE TITICACA

Indian women sorting potatoes preparatory to dividing them between families

of languages in North America, with an equally large number in South America, lead one to conclude that if man reached America from Asia, he arrived as widely scattered independent units over a period covering many thousands of years? There seems to be an increasing amount of evidence to the effect that man has been in America for a very long period of time, not merely a few thousand years. It is not beyond the realms of possibility that agriculture in America may be quite as old as that of Eurasia. To explain maize in its myriads of forms as a cultivated plant with nothing known "in the wild" closer to it than teosinte, a grass so different from maize that it constitutes a different genus, would seem to indicate a very ancient agriculture. The same claims might be made for the very numerous varieties of the cultivated garden and field beans, another great American contribution to agriculture.

The dog may have been brought from

Asia by early man in his migrations, or may have been received later over a northern route. In all probability man reached America before the period of permanent agriculture in Eurasia, but even had he left Asia after the development of agriculture, he would have lost the art and all knowledge of it in the long period passed as a nomad in regions inimical to agriculture, such as north-eastern Asia and the northern part of North America. His migration was not one consummated in weeks, in months, or even years, but occupied generations. As he journeyed south he came in contact with native plants bearing edible seeds, fruits, and tubers, with the qualities of which he became familiar through empiricism. From these, in the course of time—and this probably means many thousands of years—he gradually selected those best suited to his needs, and it was on these strictly native plants that he based an agriculture the equal of any

that was originated in the Old World, including very extensive irrigation systems in our own southwest and in Mexico, as well as in South America, where terrace agriculture also was highly developed. On the foundations of this agriculture his later civilizations were built. If primitive man could develop a high grade American agriculture solely on the basis of native wild plants, why must we invoke Eurasian contacts to explain his civilization? Considering the origins of cultivated plants in relation to the origins of civilizations, one logically concludes first, that as agriculture was autochthonous in America, early civilizations were also autochthonous; second, that man's development in America roughly paralleled his progress in Eurasia; and, finally, we do not have to look to Europe or Asia for the influences that shaped and developed the pre-Columbian civilizations in America.

The study of ethnobotany in relation to the origins of cultivated plants, of agriculture, and of civilization, is a fascinating but exasperating subject. Some of our cultivated plants have been so changed in the process of selection and development over some thousands of years, that we cannot always with absolute certainty state that a particular wild species was the ancestral form of this or that cereal or vegetable. How diverse in form may be the development of cultivated plants is testified to by the cabbage, cauliflower,

Brussels sprout, turnip, and rutabaga, all apparently derived from common ancestors, either one native species or a small group of closely allied ones belonging in a single genus, *Brassica*.

The early records are very scanty, as would be expected, and accurate identification from fragmentary remains is often most difficult. Individuals have interpreted the same data very differently and many errors in identification have been made. Printed conclusions of taxonomists, ethno-botanists, archeologists, anthropologists and others bearing on this complex subject cannot always be accepted, as sometimes they were based on insufficient or misunderstood data.



Photograph from Ewing Galloway

HARVEST TIME IN THE UNITED STATES

Showing modern methods used in the harvesting of potatoes in the Atlantic States



Photograph from Ewing Galloway

CATERPILLAR TRACTOR IN A 1200-ACRE WHEAT FIELD

Showing the operations of wheat growing on a large scale in the American West

Not infrequently arguments have been based on preconceived ideas, and only those data supporting the theory have been cited, those opposing it being ignored or overlooked. Thus one man proves to his own satisfaction the rather strange thesis that the coconut must have been native of tropical America; but a few years later another investigator very clearly demonstrates that not only could the coconut *not* be native of tropical America, but that it did not even occur in America until after 1500. Others have argued for the pre-Columbian occurrence of the banana in America, when it is well known that the plant was introduced by Europeans from tropical Asia, via the Canary Islands. Another has claimed that tobacco is a native, not of America, but of Africa, in spite of the fact that all dependable evidence points indubitably to its American origin. In the latest comprehensive monographic treatment of

Cucurbita—the genus to which the squash and pumpkin belong—ten species are recognized, but curiously the four cultivated ones are thought by the author of this monographic treatise to be natives of central Asia, in spite of the fact that all the wild species are known only from America. The botanical evidence thus points unmistakably to an American origin for the cultivated species and this is corroborated by remains found in pre-Columbian graves in Peru which unquestionably represent the squash. Obviously, if the cultivated species originated in Asia, there should be wild forms of the genus growing native in the eastern hemisphere; but none have ever been found there.

From a study of bottom deposits in the vicinity of ancient lake dwellings in Switzerland we know the basic food plants utilized by these early lake dwellers; for the charred remains of grains, where

dwellingings were burned, have retained their form through the ages, permitting accurate identification. From a study of the contents of ancient tombs, inscriptions, bas reliefs and sculptures, as well as from ancient manuscripts, we know the basic food plants of ancient Egypt. From similar sources we know the essential food plants utilized in Mesopotamia, ancient India, Mexico, and South America.

We may trace the spread of a word in modern times, such as coffee from the Arabic *gahwe*, or tea from the Chinese *tay* or *cha*, and find these words to be practically the same in all modern languages—the Germanic, Romance and Slavic groups, as well as the Japanese, Hindustani, Malay, and other languages of Asia—obviously spread by commerce in the product within the past two or three hundred years; for coffee some of the forms are *kahwa*, *kawa*, *kapi*, *kofe*, *cafe*,

cofe, *kaffee* and *koffee*; for tea, *ta*, *thé*, *thee*, *tè*, *té*, *cha*, *chai*, *chha*. Similarly we can trace the introduction of economic plants of Indian origin into the Malaysian region some 2000 years ago, through their Sanskrit names which are now incorporated in the present Malaysian languages; also the introduction of numerous economic plants from Mexico into the Philippines after 1550, their Aztec names now being found incorporated in the Philippine languages. Or we may ponder the significance of the name *niu*, which in slightly varying forms is used for the coconut in the native languages from Madagascar through Malaysia to Hawaii and the Marquesas Islands, such as *niu*, *niuh*, *niog*, *ni*, *nia*, *nioe*, *noe*, *nor*. It seems likely that the name *niu* was carried in prehistoric times with the plant itself by the migratory peoples who populated these widely separated areas.

We thus seek our corroborative evi-



Photograph from Ewing Galloway

WHEAT HARVEST IN THE WESTERN UNITED STATES

Two big combines harvesting a 1400-acre wheat crop. These harvesters, threshing as they go, cut sixteen-foot swaths

dence in widely scattered fields, including the early classical literature of the Greeks and the Romans, the writings of the ancient Egyptians, the Bible, and the early literature of India and of China; in the special field of early European scientific literature, particularly the herbals of the Fifteenth and Sixteenth Centuries, and the other botanical publications of this period; in the enormous accumulation of literature on systematic and economic botany; in early books on travel and exploration; in old manuscripts and government records; in the literature of history, archeology, ethnology and anthropology; in comparative philology, and in the too little developed field of ethno-botany.

What I have attempted to demonstrate in this paper is the important bearing that the origins of cultivated plants have on certain much discussed theories relating to man in pre-Columbian America. I have indicated the correlation that exists between the places of origin of cultivated plants and those of ancient

civilizations. The botanico-agricultural evidence would seem to support the idea that agriculture was originally developed in regions of limited rainfall, in parts of the world with an equable climate approaching the Mediterranean type, and not in the humid tropics nor in the cooler, more humid parts of the North Temperate Zone. Emphasis is placed on the fact that in pre-Columbian times there was no general world-wide distribution of cultivated plants and domesticated animals, but that those characteristic of Eurasian and pre-Columbian American agriculture were each confined to their respective hemispheres.

This subject is one that deserves more critical attention on the part of botanists, anthropologists, and archeologists than it has received in the past, and is one that offers an inviting field for productive coöperative research. We can now paint the outlines of our picture in bold strokes, but there still remains ample opportunity for intensive work on minor details.



Photograph from Ewing Gulloway

WHEAT FARMING IN INDIA

A native woman harvesting wheat by hand

THE MASTER BUILDER: HENRY FAIRFIELD OSBORN

An Appreciation of the Honorary President of the American Museum of
Natural History at the Close of His Twenty-five Years' Service as
President of that Institution

BY WILLIAM KING GREGORY

IN the middle of Manhattan Island, in the ages following the gradual melting and retreat of the great glaciers, there was a well-wooded region dotted with small lakes and meandering streams. Rounded ledges of mica-schist bore parallel grooves made by the grinding ice, while great boulders were scattered about as additional souvenirs of the old Ice Age. Passing over the intervening millenia and even disregarding the arrival of the white settlers and the comings and goings of Revolutionary troops, we discern nothing of great historical value to our theme until the period of A. D. 1853, when Andrew H. Green, the Father of Central Park, was inspired, doubtless by Heaven, to preserve this beautiful region to posterity. Thus we may say that without the preparatory work of the Ice Age and without the preservation of Central Park and its annex Manhattan Square, the American Museum of Natural History would not be what it now is.

Coming to the written history of the Museum, we may also affirm that an important part in its foundation was played by Prof. Albert S. Bickmore, an energetic and energizing young man from the Museum of Comparative Zoology at Cambridge, who was determined to bring the beauties of nature within the vision and understanding of the people. But in 1866 Professor Bickmore, representing the worlds of education and natural science, could become effective only by enlisting the coöperation of citizens of wealth and culture who readily appreciated what had

already been done by the museums of Europe. Among the gentlemen who in 1868 secured the collections that were to be the nucleus of the Museum were John David Wolfe, Robert L. Stuart, Morris K. Jesup, and J. Pierpont Morgan. William A. Haines, who also took a very active part in the creation of the Museum, was an expert conchologist and owner of a famous collection of shells that eventually came to the Museum. He represented a class of wealthy and accomplished amateur naturalists who have done much to advance the Museum's exhibits and collections.

From the first the Museum was in partnership with the City, which provided a home for its collections and exhibits. The new-born Museum was cradled in a part of the old Arsenal Building in Central Park in 1869.

The growth of the Museum during the successive administrations of Presidents John David Wolfe (1869-1872), Robert L. Stuart (1872-1881), and Morris Ketchum Jesup (1881-1908) was very rapid, for by 1877, eight years after its foundation, we find the Museum installed in the central unit of its present building, with the collections of birds, mammals, rocks, minerals, shells, etc. This excellently designed building, which was many times larger than the first rooms in the Arsenal, was, however, soon to be found inadequate for the rapidly expanding collections. After another few years we behold in place the south central section, containing the main entrance hall. Then the southwest

wing, the auditorium, and southeast wing were added and finally the towers at the east and west ends of the building.

By this time (1899) the Museum building occupied the entire south front of Manhattan Square, some seven hundred feet in length, extending between Central Park West and Columbus Avenue. The west wing, on the Columbus Avenue front, was begun in 1905.

This immense expansion in building of course only reflected the still greater growth and activity of the Museum itself: in sending out scientific expeditions, in securing and working out collections, in preparing and installing exhibits, in conducting investigations, in developing a library, in publishing a great series of scientific bulletins, and in giving lectures to thousands of its members and friends, and to millions of school children. Such then was the Museum during the memorable presidency of Mr. Morris Ketchum Jesup.

This remarkable man contributed

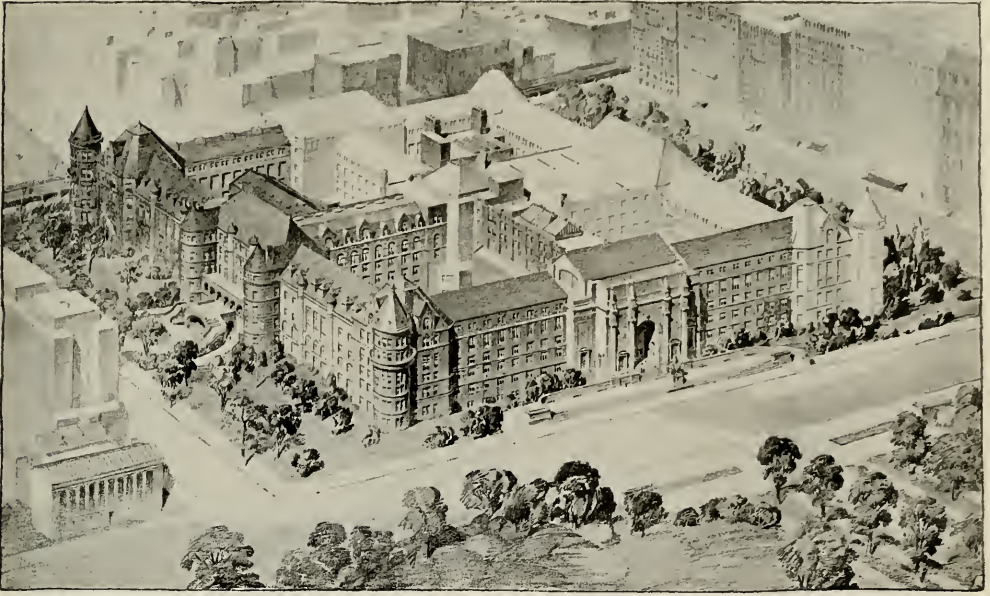
\$450,000 to the Museum during his life-time, while he and Mrs. Jesup in their wills left six million dollars for the endowment of its scientific and educational work. Among the earlier members of his scientific staff to whom he looked for counsel and advice were such eminent men as Prof. Albert S. Bickmore in the department of education, Prof. Frederick W. Putnam in anthropology, Prof. R. P. Whitfield in geology, Dr. Daniel Giraud Elliot and Dr. J. A. Allen in mammalogy and ornithology. On the side of exploration Mr. Jesup backed Commander Peary in the latter's numerous and finally successful efforts to reach the North Pole; adopting the plans of Prof. Frederick W. Putnam and Prof. Franz Boas, he founded and sustained the Jesup North Pacific Expedition and sent many parties into northeastern Asia and northwestern North America to study the grand problem of the coming of man to America.

All these and other great projects begun during Mr. Jesup's time were loyally



THE AMERICAN MUSEUM IN APRIL, 1895

Showing the old north wing, the central, and the southeast wings, on west Seventy-seventh Street



THE COMPLETED MUSEUM

As envisioned by Professor Osborn. The parts erected up to date are fully shaded

carried out and largely completed during the presidency of his successor, the subject of the present article, who has also initiated and carried out an even greater number of far-reaching enterprises.

Prof. Henry Fairfield Osborn had been a student of Doctor McCosh at Princeton and of Huxley and Balfour at Cambridge. At the time when by Mr. Jesup's invitation he came to this Museum to found the department of vertebrate palæontology (1891), he was professor of comparative anatomy at Princeton and already well known for his researches and publications on the fossil mammals of western North America.

Transferring his activities to Columbia University, where he became professor of zoölogy, and to the American Museum of Natural History, Professor Osborn, with Mr. Jesup's financial support, soon acquired by purchase the very extensive collection of fossil vertebrates belonging to Prof. E. D. Cope of Philadelphia. Thereafter year after year, with the aid of Jacob L. Wortman, W. D. Matthew,

Walter Granger, Barnum Brown, and others, Professor Osborn conducted an intensive systematic geological and palæontological survey of the West, which was later extended to Egypt, India, Mongolia, China, Burma, Alaska, Mexico, Patagonia, and other countries. Thus was amassed what is easily the most extensive collection of fossil vertebrates in the world, while the numerous monographs and articles in Museum publications by Professor Osborn and his staff have revealed a vast panorama of the evolution and dispersal of the vertebrates during the Age of Reptiles and the succeeding Age of Mammals.

In 1899 Professor Osborn was appointed assistant to President Jesup, and in 1908, upon the death of Mr. Jesup, he was elected president of the Board of Trustees. From that day to this Professor Osborn has willingly carried a vast and constantly growing burden upon his strong shoulders.

This burden might well have proved too much even for him if he had not discovered real magic in his consistent application of



BONE CABIN CAMP

Professor Osborn and his party at Bone Cabin Quarry, Wyoming, in the summer of 1899. Front row: Fred Suyder, Walter Granger, Professor Osborn, W. D. Matthew. Back row: R. S. Lull, Albert Thomson, and Peter Kaisen



IN THE FAYÛM

Professor Osborn in Egypt in 1907 on the expedition to the Fayûm where a collection of Tertiary fossils was made for the American Museum

Photograph by Walter Granger

AN EARLY WESTERN
EXPEDITION

Professor Osborn and
Barnum Brown at the
Diplodocus Quarry, Au-
rora, Wyoming, 1897,
showing the first dino-
saur skeleton ever exca-
vated by an American
Museum expedition



TIFFIN ON THE GOBI
DESERT

Professor Osborn was a
visitor to the Central
Asiatic Expedition to-
ward the close of its 1923
season

Photograph by
Roy Chapman Andrews



the rule "Divide and Conquer." In adhering to this principle Professor Osborn has played many leading parts, in the Museum, in the New York Zoological Society, in the Roosevelt Memorial Commission and other organizations, but he has always insisted upon a well arranged schedule of limited engagements. Thus on certain mornings of the week, until his recent resignation, he has acted in his capacity as president of the Board of Trustees of the Museum, sitting in the Board Room and transacting business of the greatest importance. After luncheon, on certain days, he has gone to the department of vertebrate palæontology, meeting his staff there and planning with them the superb exhibit of fossil Proboscidea or the spacious architectural effects of the newly-arranged Hall of Fossil Mammals. At other stated times he is closely walled up in his Round Tower, forgetting everything but his beloved fossil elephants. Thus his mind works with singular detachment and concentration upon the matter on the docket before him.

Professor Osborn is the author of almost nine hundred publications, varying in length from brief articles in the Museum *Novitates* to the huge monographs on the Titanotheres and Proboscideans. He has also written such well known scientific and educational books as *From the Greeks to Darwin*, *The Age of Mammals*, *Men of the Old Stone Age*, *Man Rises to Parnassus*, etc. His truly colossal scientific output has been acclaimed by the learned world, and he has received a long series of honorary degrees, fellowships, medals, and awards, from some of the greatest universities and scientific societies in the world, such as the Royal Society of London, the Geological Society of England, the Société Géologique de France, the National Academy of

Sciences of America, and many others.

During the twenty-five years of Professor Osborn's administration, no fewer than six immense buildings have been added to the Museum, while hundreds of thousands of specimens have poured into its numerous departments. Thus the Museum is now about twice as large as it was at the beginning of his administration, while it is safe to say that during the same period its scientific scope has been greatly widened and its prestige and influence have become world-wide.

The New York State Memorial to Theodore Roosevelt, now nearing completion, will really be the seventh great building erected in Manhattan Square under Professor Osborn's supervision, for as president of the Board of Trustees of the Theodore Roosevelt Memorial Commission he has taken a leading part in the movement to perpetuate in this noble building the memory of his old friend and fellow naturalist, whose life he holds up as a shining example to the youth of America.

In all these great works Professor Osborn has been the first to recognize the aid of his co-workers and assistants, but he himself has been the brilliantly successful leader of the whole movement. On occasion he has disregarded conservative advice and with unshakable faith in the power of his ideals has pressed forward with the greatest courage and persistence until he has secured for the Museum one after another of its major prizes,—new buildings, new collections, new explorations, and an ever greater and more far-reaching organization for the diffusion of science and education.

It is therefore with affectionate pride and loyalty that the Museum now greets him as its Master Builder and heartily wishes him many years of happiness as its Honorary President.



Young Golden Eagles

CAMERA HUNTING IN THE HAUNTS OF THE GOLDEN EAGLE

Some Wild Life Studies Taken in the Region Between the High Plains
of Eastern Colorado and the Summits of the Rockies

By A. M. BAILEY AND F. R. DICKINSON

PHOTOGRAPHS BY THE AUTHORS AND R. J. NIEDRACH

MANY early explorers of the American wilderness seem to have thought of its wild life chiefly in terms of a square meal between intervals of fasting. Occasionally their records include an incidental attempt to describe species of birds, mammals, or plants new to the observer and perhaps to science, but often the accounts are more replete with notes on the flavor of the flora or fauna found along the route than with data on their specific peculiarities. After the country had grown more settled came an era of scientific collection, ushered in by government expeditions on which a more or less successful effort was made to bring back samples of whatever struck the fancy or aroused the curiosity of the leaders; and though some of the information gained in this way had value, much of it was too inaccurate to

count for a great deal. The appendices of certain early reports, indeed, describing items collected during the expedition, rather remind one of the old jingle recounting the field work conducted by a shipwrecked mariner, with the aid of his companions, a dog, a cat, and a parrot:

So we gather as we travel, bits of moss and dirty gravel,
And we chip off little specimens of stone;
And we carry home as prizes funny bugs of handy sizes,
Just to give the day a scientific tone.

If the explorer failed at times to achieve the true scientific tone, having such considerations as hostile savages and impending starvation to occupy his leisure moments, it was not long before natural history museums began to increase in number and send out field representatives to comb all parts of the continent for



**GNARLED BRANCHES OF
THE BRISTLE CONE PINE**

Typical of the region described in the accompanying article are these bent and twisted trees



**HAZE-FILLED VALLEYS OF
THE HIGH FOOTHILLS**

This scene is representative of a great portion of the higher foothills of the Rocky Mountains

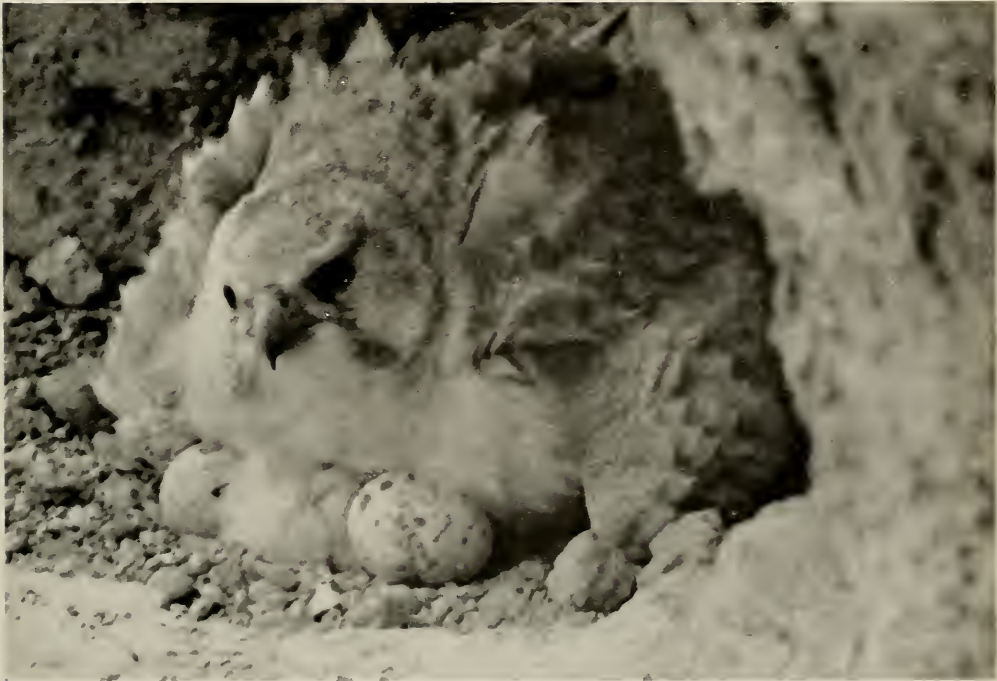
GOLDEN EAGLES NESTING

Photographs of golden eagles are none too common, especially a family group such as this



A PRAIRIE FALCON

As rare a photograph as is the one above, this remarkable picture shows a nesting bird in the Colorado foothills





SUMMER ON THE PRAIRIE

Young prairie dogs stay close to home where three kicks land them in deep holes, safe from the hawks and the coyotes

abling the field naturalist to bring his work in popular guise before the public of interested amateurs.

On a recent expedition for the Chicago Academy of Sciences, the authors and R. J. Niedrach, of the Colorado Museum of Natural History, spent several weeks film-

fresh material. This work was well done,—so well that now, after a few generations, the naming of a new subspecies means about as much to the taxonomist as did the discovery of a new genus to his recent predecessor.

Though the work of collecting is by no means finished, there is an allied field in which perhaps more remains to be done, namely, the preservation and observation of such wild life as has been left us by the collector, the hunter, and the trapper. In the demand for the assembling and preparation of museum groups, and the naming, comparing, and classifying of species, the study of the life habits of many birds and mammals has been somewhat neglected. This is a phase of natural history in which the motion picture will play an increasingly important part, both in recording facts of interest to the specialist and by en-

ing birds, mammals, and reptiles in one of the favorite haunts of the golden eagle, a rather vague geographical term covering in this case a region between the high plains of eastern Colorado and the summits of the Rocky Mountains. This field included the short grass prairie running to the foothills of Long's Peak, the lofty mesa country to the north, the sun-baked draws and rugged gorges to the south, the belts of pine and spruce in the lower mountains, and the bare slopes above timber line. In each of these areas we saw or might have seen the golden eagle watching from the heavens our



ROCK RABBIT

Under the name of cony, pika, or hay maker, he is happy and secure in the jumbled piles of rock, where his long-eared cousins would flounder

Photograph by Russell W. Hendee

A GRAY-HEADED JUNCO

She eyes the camera with considerable distrust as she stands guard over her nest, where she has been busily engaged in making repairs

incursion into his domain.

We began, one bright morning in early May, with a search for the mountain plover, that rather rare shore bird which nests not on shores or in the mountains, but in the solitude of prairie land unsullied by the plough. Happily, such country may still be found; and when you have left roads and ranch gates behind to strike across the range on foot, it is not hard, with the vast spread of the Rockies looming in the west and the ground decked with wild flowers, to make herds of bison out of each distant group of grazing Herefords. They fit well into the spirit of the landscape, but these same Herefords are no small menace to the mountain plover, for this bird, like so many of its near relatives, nests on the ground in a shallow, saucer-like depression, and the broad hoof of a wandering steer often blots out a promising family of nestlings.



Searching for these nests is pleasant sport on a day in spring, affording as it does a sound excuse for lying on the warm earth and letting the sun soak in. One might walk for miles without finding a nest or even seeing a plover, for the eggs blend with the soil and their owner crouches motionless at sight of so strange a visitor as man. The trick, therefore, is to do a little blending and crouching yourself, resting quietly on the soft sod and watching through field glasses for the movement of a feeding bird, which after a time is sure to go back to its eggs. One may have to spend an hour or even half a

day in this wise, but the time passes quickly and is not wasted. The Scriptures say there is a time for everything; and surely the time and place in which to regain the lost art of sitting on the ground is a cloudless May morning among the slopes of the Rockies. On this

A SAGE THRASHER

This bird inhabits the lower country where the prairies merge into the foothills. It is pale grayish-brown above and white spotted with brownish below





Photograph by J. S. Young

COYOTE

The true dog of the prairies picks the bones of horses and cattle which have died at other's hands and his. He is a lucky coyote if there is no poison waiting for him



SILVER SPRAY

"Tassel ears" replaces our gray squirrel in the west. Slower and more cautious in his movements, he is nevertheless a more handsome animal, as he is endowed with softer tones in his fur and a more beautiful tail

THE WASHER

The coon comes down to water, reputedly to wash his food, but more frequently to look for frogs and crayfish, which give variety to his epicurian diet



BIG EYES

Baby ground squirrels, sleek and alert, keep busily feeding to put on fat for the long winter's sleep. The open prairies, arid regions, and mountains are favorite haunts of these spermophiles





BURROWING OWLS

These birds are not uncommon on the prairies, where they are often found occupying prairie-dog holes

occasion, however, we soon spotted a plover, located her nest, and discovered that she was not averse to having her picture taken from a blind set up a few feet away.

During the breeding season this part of Colorado is a paradise for birds of many species, because, unlike other areas of equal size, it offers a wide variety of natural features. The apparently endless expanse of level prairie is in fact cut up by shallow draws along which owls, hawks, and many kinds of smaller birds find suitable spots for their temporary homes. On the prairie proper several species of ground-lovers are found. Here and there lie extensive stretches of marshy country where, near shallow ponds or among the cat-tails nest the avocet, phalarope, coot, ducks of several sorts, and the gorgeous and buoyant yellow-headed blackbird. A little higher, where



A MONTANA HORNED OWL

Peering out from among the branches of yellow pine, this solemn bird seriously blinked at the camera lens, and seemed more curious than frightened as the photographers made a number of portrait studies of it



BIG-HORN EWES

In some of our national parks the sheep have responded to protection enough to lose their fear and give an occasional opportunity for a picture to be made. The grouping for this one happened to be unusually artistic

the broken foothills slope down to the plains, the great horned owl begins its family cares when the ground and pine branches are still white with February snows; and near by, in the tops of the yellow pines, nests the king of all our feathered folk, the golden eagle. Lakes are not numerous, but such as there are draw myriads of water-fowl and provide ideal conditions for wading birds, notably bitterns, black-crowned night herons, and Treganza herons, some of which maintain nesting colonies for years in the same spot.

With such a wealth of scenery and bird life to choose from, we found each day full of new and memorable sights and sounds. One of our excursions, for example, took us for several miles over the sandy floor of a shallow draw, in quest of the short-eared owl. For anyone alert to the indefinable sense im-



WHAT'S THAT?

Curiosity is only slightly less controlling than fear, and the ground squirrels stay outside their tunnels as long as they dare



WHITE-TAILED PTARMIGAN

In their white winter dress these birds are difficult to see against a snowy background

as we came to a tree with low spreading branches something not quite natural caught our notice. A second glance showed us a nest and in it a short-eared owl. She seemed more curious than alarmed, watching us with rotating head as we rigged up our blind in a near-by tree and

strapped the camera to a handy branch.

pressions which help to create a mood, there can be few pleasanter experiences than a day spent in the silence of one of these empty river bottoms.

As we moved slowly from bend to bend, looking for nests in the low branches of the cottonwoods, the cut-banks on either side gave shelter from the breeze, the sun struck warm on the flats, and every secluded corner was aromatic with budding shrubs and early flowers. In the remoteness of that forgotten place time seemed to stand still. With no great effort of the imagination we could repopulate the shady groves along the stream bed with the ghosts of emigrants resting beside their covered wagons, or with an encampment of Plains Indians home-bound after a foray in the south.

For an hour or so we saw no sign of life except a pair of playful woodpeckers, and heard no sound save the wind in the cottonwoods. Then

MOUNTAIN BLUE BIRD

One of the most attractive of the many inhabitants of the region described in the accompanying article



HAIRY WOODPECKER

Returning home with a good-sized morsel. This is one of the numerous American species

blind and the blaze of light without, or the clamor of bird voices assailing us from every side, gave the picture a startling brilliance. There is a certain detachment in studying birds through a slit in the wall of a bird blind. You are in the picture but not part of it. Life goes on about you as though you were not there, and it becomes easy and pleasant to imagine that miraculously you have stepped back into primeval times.

Unconscious of our presence, the little phalaropes steered their way about over the ruffled surface of the pond like mechanical toys, bobbing their heads and thrusting out their slender bills in pursuit of food. A pair of coots, in no hurry to assume the duties of parenthood, sat quietly on the bank, preening their feathers in the noonday sun. A yellow-headed blackbird, very busy about a nest in the reeds, teetered between times on the end of a tall stalk and sang of springtime.



And at last a dainty avocet, whose nest lay a few feet from our waiting camera, took a final look, made up her mind, walked sedately forward, folded up her preposterous legs, and without more ado, sat down to brood.

Quite different from this peaceful spot was the home of the golden eagle. In the lower foothills we noticed one day a distant pine tree in which, near the top, hung a dark mass that might or might not be a nest. Suspicion was confirmed by sight of a moving speck in the sky; and an hour later, with the help of ropes, we stood sixty feet above ground on the edge of a rude platform of sticks and rubbish in



company with two outraged eaglets. It was a fit nesting place for these greatest of North American birds of prey. From the day they are hatched they look off into blue space. For them the earth is but a background against which to spy the form of a luckless prairie dog or rabbit.

MARSH HAWK

The many frogs, snakes, and smaller rodents of the prairies and foothills are the favorite prey of the marsh hawk



YOUNG COOPER HAWKS

These four young birds on their bare limb give little idea of the ferocity with which they can attack prey

Against the mountain wind which sways their pine tree they have and need no shield, for it is the element into which they must soon launch for life. How well nature prepares them for that day was brought home to us a little later while watching another brood of eaglets in a niche on the side of a cliff in the mesa country to the north. They were fully feathered and almost ready to leave. Above them was a sheer wall up which a fly could hardly have crawled, below them a vertical drop of three hundred feet. Their first flight must be a solo flight, and there must be no engine trouble. What had they done about it? Well, they had been conducting a home school of aviation. Every day at intervals they stood erect on their ungainly legs and went through setting-up exercises with their wings. By the time they had gathered strength to hover above the nest, they were ready for their great moment, and instinct, whatever that may be, was there to help them the rest of the way.

In this same mesa country lives one of the swiftest, fiercest, most graceful of all our birds of prey, the prairie falcon. Awkward and apparently stiff-legged on land, it is speed incarnate in the air. Nesting on inaccessible cliffs, it hunts smaller birds and mammals and, relying on its dexterity, will even drive an eagle from its preserves. Among the smaller neighbors of the falcon are two in which we took special interest, the lark bunting and McCown's longspur. The former, State bird of Colorado, nests freely over a wide range. Small flocks of males, showy in their black and white plumage, often flew abreast of our car for long distances, gauging their speed by ours and apparently able without effort to maintain a rate of more than forty miles an hour. The longspurs' breeding range in the State includes the northwestern section, where it lays its eggs on the ground in a nest beautifully woven from dried grass and lined with hair and feathers.

This mesa country, home of the falcon,

is as fascinating to the botanist as to the student of birds. Behind the escarpments of the eastern front lies a plateau which to the falcon's eye, if it registers color, must at times look like a vast Persian rug, patterned with threads of gold, purple, lavender, gray, and green. Dwarfed by the rigor of the winters and the chill of summer nights, the plants carpeting the soil are low, and have the dry, leathery texture common to many sub-arctic species; but their beauty of color, their abundance, and their strange forms are a never-ending delight to the wayfarer. To the amateur taxonomist who would attempt their identification they are a source of despair. As one moves from north to south along the edge of the mountains or makes excursions up or down from one life zone to another, it is interesting to note the gradual change in the vegetation. On the mesa most of the blossoming species were

only an inch or two in height, though many single plants spread their leaves in rosettes six inches or more across. Farther south or lower down these dwarf species gave way to closely allied forms of much greater height. As one moves on through the Transition and Upper Sonoran zones, the sand lilies and Easter daisies of the prairie region give place to masses of golden banner and the brilliant yellow shafts of *Stanleyi*, thriving in country where only the cactus seems fitted to survive.

The stream beds, cactus flats, and low pine woods south of Canyon City harbor a number of birds not commonly found farther north. The sage thrasher and house finch, otherwise apparently sane, raise their young in the prickly thickets of *Opuntia*, darting carelessly in and out among the needle-like thorns as they stuff their fledglings with captured insects. Among the broken foothills, within the



RED-SHAFTED FLICKER

The parent is obviously alert to the proximity of the photographer, while the insatiable appetites of the youngsters seem to be momentarily forgotten

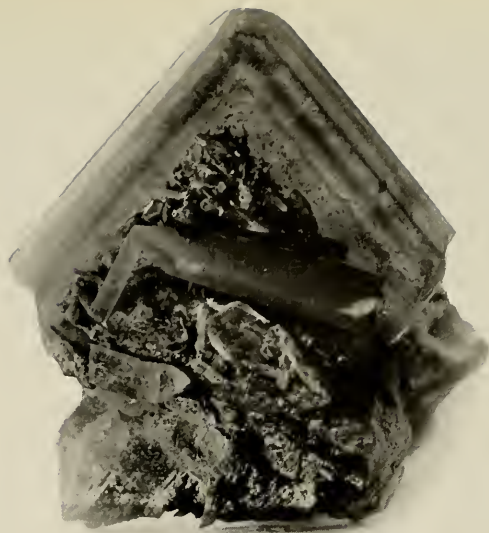
cool recesses of some narrow gorge, the water ouzel, or "dipper" builds a sketchy nest on a sloping rock-face just above the spray line. Following an inscrutable law of evolution, this little creature, though not endowed with the ordinary structural modifications of the wading or diving birds, there proceeds to pick up a living under water from the stony bed of the stream. One would think that a retiring water insect, snug beneath a pebble under a foot of running water, might congratulate itself on security from intrusion. Nature ordains otherwise.

Here and elsewhere in this western country, observers who know how, can find many species of mammals. The eagle, the owl, and the falcon know when and where to look, for their living depends on such knowledge; and even man, though he has forgotten most of what he once knew, can see much by merely keeping his eyes open. Big-horn sheep still graze and watch for enemies on steep slopes, the cougar still tracks the deer. Bison are gone, but bear, antelope, and elk are fairly plentiful. Among the lesser sorts, one of the most amusing animals is the inquisitive prairie dog. As you approach his village, all is silence, the sandy mounds are deserted, the only movement is in the quivering heat waves

above the flat expanse of the range. Find a patch of shade, if you can, and lie down in it. Presently you will hear the beginning of a muffled, subterranean argument in prairie dog talk. Caution is saying, "Stay down"; curiosity replies, "Go up"; and of course curiosity wins. Here and there a brown head emerges, a small body rises half erect, one front paw tentatively on the ground. On all sides beady black eyes and twitching noses examine you from a safe distance. Remarks are shot from burrow to burrow. Conservative cousins issue warnings and advice from below ground, but finally succumb and pop out to have a look. With modest pride you realize that for once you are big news, the sensation of the day.

We had hoped to end our trip by moving still farther south into the sand and sage brush where many other forms of wild life tempted us forward,—but time was too short. Before turning back we climbed high among the foothills and took a last look at the simplest and most appealing landscape on our entire continent: the great plains, visible in the late afternoon for a hundred miles or more. Only sand, sage, and sky, arid, bleak in winter, torrid in summer,—yet somehow reassuring in their indifference to change.





CLEARLY MARKED
PHANTOMS IN
BARITE

CONCERNING PHANTOMS

A Series of Illustrations of Crystal Growth with Explanatory Notes

By HERBERT P. WHITLOCK

Curator, Minerals and Gems, American Museum

MUCH had been written and still more has been said about the distinctions between the inorganic world and the living world of organisms.

Mr. A. E. H. Tutton has said, in *The Natural History of Crystals*, 1924: "It is a remarkable fact that no definition of life has yet been advanced, which will not apply to a crystal with as much veracity as to those obviously animate objects of the animal and vegetable world which we are accustomed to regard in the ordinary sense as 'living.'"

A somewhat neglected criterion of difference between these two essentially different types of natural substances is furnished by the manner in which they assume additional matter, or as we would say, *grow*.

An organism, whether a plant or an animal, increases through the addition of matter from within, appropriating through the functioning of its organs such parts of this matter as it needs for

the increase of its tissue. Both animals and plants absorb food from their surroundings, and transform such food matter, *within themselves*, into parts of their organization.

The forms produced by crystallization, which is the organizing or structure-making principle of inorganic nature, appropriate matter of their own kind outwardly, layer upon layer. Organisms grow from within, crystals grow from without. Because of this growth by the addition of matter from the outside, we are sometimes enabled to trace the growth stages through which a crystal has passed, by observing through the transparent substance of such a crystal outlines representing the size and shape of it at a former time before it had attained its present outline. In such cases it is almost as though we could actually review the "life history" of a portion of crystallized matter by means of the "phantom crystal" or, in some cases, the succession of phantoms.

SMOKY QUARTZ PHANTOM IN
CLEAR QUARTZ

At one point in the growth of this quartz crystal the watery solutions, heavily charged with silica, became also charged with the smoky organic coloring matter that left a record of this change in the dark outline seen within the crystal. At this time the quartz crystal was the exact size and shape of the dark "phantom." It grew later to its present size through the addition of silicon and oxygen atoms, which, however, were unaccompanied by coloring matter in this last stage

MULTIPLE PHANTOMS
IN QUARTZ

At least fifteen changes have taken place affecting the minor composition of the silica solutions producing this quartz crystal during the period of its growth. These are recorded in the succession of phantoms seen in the illustration



"SKELETON"

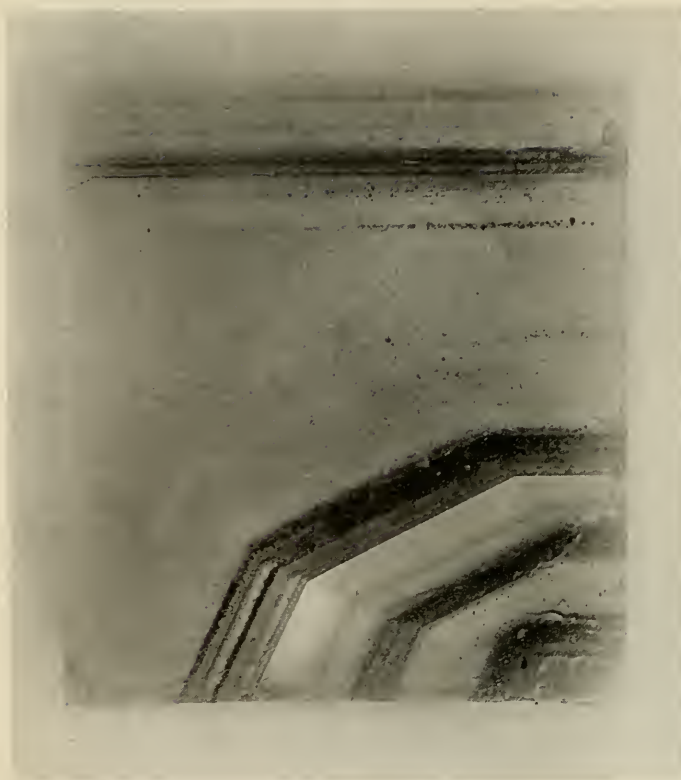
PHANTOM IN QUARTZ

By some subtle selective process, which seems almost to suggest a living agency, the hydrous mica that at one stage coated the end of this quartz crystal, built ridges on the crystal edges

TWO VIEWS OF A PHANTOM FORMATION IN QUARTZ

The phantom within the crystal at the lower right clearly records what has taken place during the growth of the crystal. At that time certain crystal faces were coated with a thin crust of tiny mica scales, much as a window pane is coated with frost. In fact this thin coating of mica looks very like a frost pattern made by watery vapor. At the left another view of the same crystal reveals seventeen additional phantoms, later in generation than the more obvious one and each exactly parallel to it





SUCCESSIVE PHANTOMS IN ROCK SALT

A beautiful series of phantom crystals outlined within this block of rock salt by coloring matter, which, at the time that the block of salt (crystal of halite) was of these respective sizes, rendered the brine solution that was building it muddy and discolored. The clear spaces between the phantoms stand for intervals when the salt-building brine was clear. Many dim phantoms not visible in the illustration show in the specimen



FLUORITE CLEAVAGE SHOWING PHANTOM

Within this cleavage octahedron of fluorite are visible rectangular patches of reflective films. These in reality represent all that is left of phantom outlines of which they at one time constituted the rectangular cube face

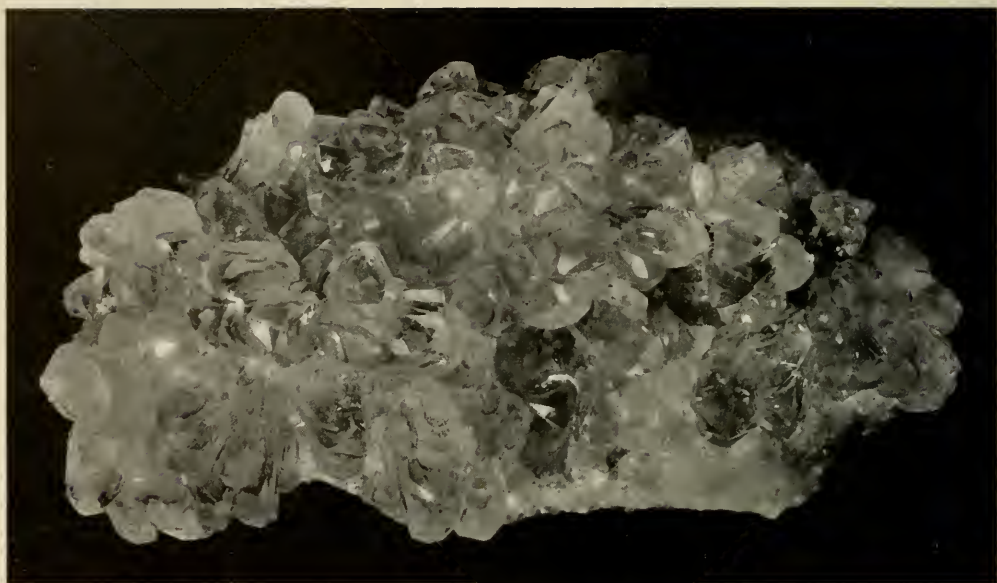
A CHANGE OF CRYSTAL HABIT

The phantom within this crystal of calcite is of quite a different shape from the crystal representing the final stage of deposition. The early stage of calcium carbonate formation was evidently influenced in some way by the physical and chemical conditions attendant on the atomic building to produce a pointed steeple-like crystal form (scalenohedron), whereas the forces influencing the later stages built up around this phantom a six-sided prism capped by a low rhombohedron



PHANTOM CRYSTALS IN BERYL

Enlarged about six times to show the succession of phantoms in the form of parallel pyramids, the planes which are also parallel to those that bevel the edges between the hexagonal prism and the prominent basal plane of the enclosing crystal. Note that, as was the case in the calcite phantom shown above, the phantom represents a crystal habit distinctly different from that of the enclosing crystal



SELECTIVE ENCRUSTATION ON A PHANTOM IN CALATE

The calcite crystals show phantoms outlined by encrusting deposits of hematite scales, disposed more thickly around the planes of the terminations. To explain the genesis of this expression of calcite growth, we have but to extend the process that built up the crystals shown below enveloping the latter in clear calcite in and on which no hematite has been deposited



SELECTIVE ENCRUSTATION ON CALCITE CRYSTALS

These beautifully modified calcite crystals were formed in close proximity to a body of iron ore. Some of the iron oxide, which colors red the phantom outlines of early growth stages, also appears as black hematite encrusting the planes of the termination. Note especially this latter *selective* encrustation

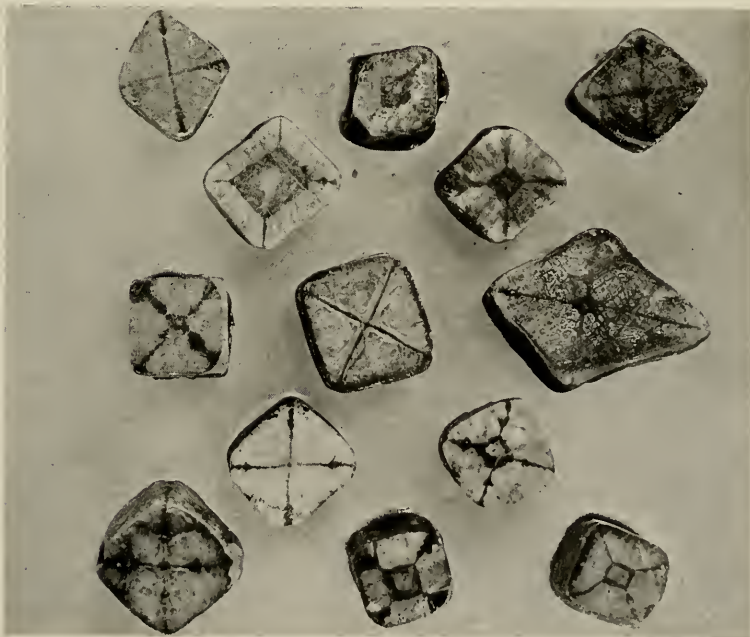
So the changes of crystal habit, that is to say the changes in presence and relative development of certain crystal forms, which are themselves indications of differences in the conditions affecting crystal growth from solution, are sometimes accurately recorded within the crystallized individual.

Occasionally we encounter a whole series of these phantoms, appearing ghostlike one above the other, and always with their sides exactly parallel following the unalterable law by which their atoms build one upon the other.

Nor do the phantom outlines within the crystal exhaust the resources at the disposal of these congruent building particles, to record their structural processes. Often there are left tiny, hollow cavities, voids unfilled with matter, which by very

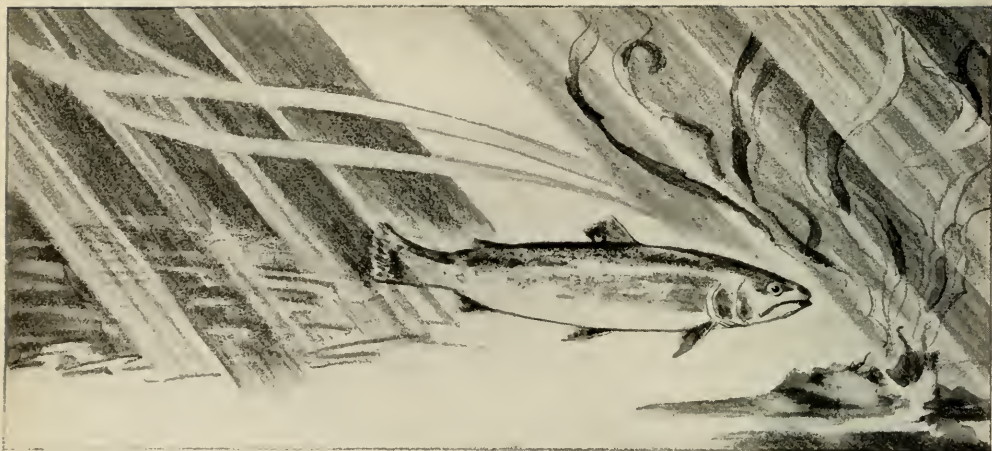
reason of their emptiness express in no uncertain terms the laws of their fashioning.

In certain cases there appear faint shadows, veritable phantoms of a phantom, to show us by means of their dim but highly geometric outlines the portions of the crystal substance where for some reason, connected with its complex genesis, coloring matter has failed to "register." We have every reason to connect these latter with the inclusions which so marvelously decorate the interior of such a mineral as andalusite with crosses, squares, and tessellated figures. These are but a few of the manifestations of phantoms among minerals. The accompanying illustrations will carry on the story of this phantasmagoria of realities, or better yet, the things themselves will open to us an unrealized world.



CARBONACEOUS INCLUSIONS IN ANDALUSITE

This group of cross sections shows the results of sectioning a number of orthorhombic crystals of the mineral andalusite (a silicate of aluminium). The remarkable patterns shown in these cross sections is due to the regular arrangements of particles of carbonaceous impurities within the crystals during their formation. Although not in a strict sense phantoms these regular patterns, crosses, rectangles and tessellated figures are intimately bound up with the atom-building processes which have produced these crystals



A TRAILSIDE CONVERT

A Fisherman Visits the Trailside Museum

By WILLIAM H. CARR

Assistant Curator, Department of Education, American Museum

WITH FIVE ILLUSTRATIONS BY JOSEPH GUERRY

The Nature Trails and Trailside Museum maintained by the American Museum of Natural History and the Commissioners of the Palisades Interstate Park, at Bear Mountain, have been built during a period of seven years to benefit the people of Greater New York. The project is an educational undertaking with the aim of acquainting visitors with the world in which they live.—THE EDITORS.

WHEN, over a long period of years, a person has held erroneous ideas with regard to various aspects of wood-lore, it becomes a difficult task to correct his impressions. The more stubborn such a person is in refusing to alter his opinions, the more interesting becomes the prospect of encouraging him to correct the evils of his ways. Everyone is a reformer at heart, especially when the reformation has to do with someone else!

The Trailside Museum has many purposes other than merely combating wrongly conceived ideas. Regardless of this, some of our happier experiences have come through meeting challenges of obstinate folk who would not be convinced. They are legion.

Our Museum is a very informal place, as you shall see. One day a man with a New York State fishing license pinned to his coat and several trout flies hooked in a

disreputable hat band, stalked into the little woodland museum and sat down heavily in a chair. Placing his muddy boots upon a convenient table, he tilted backward and surveyed the fish collection in the tanks before him. There is never anything formal about a fisherman, at least not when he is on a fishing trip. While we by no means encouraged behavior of his particular kind, we nevertheless made allowances—after all, the trout season was nearly over!

We have divided fishermen into three types: first, the sort who fish for a living; second, the ones who just fish; and third, those who fish for trout. Our visitor was of the last sort. He had stumbled upon our Museum when about to cross the Bear Mountain Bridge that spans the Hudson River near by.

"You've quite a place here," he said expansively, as we walked over to greet him. "These fish are small, though. Why,

last week a friend of mine caught a pick-erel three times as long as that one."

He referred to an eight-inch, beautifully marked fish swimming about in the tank.

"Why don't you go after a big one?"

We explained that our only object in maintaining a fish collection was to show people the different common species found in the Park; size did not matter, provided the fish was represented by a typical individual.

"You could see him better if he was larger," was the man's only comment.

He arose and peered short-sightedly at the two robust, phlegmatic catfish that were lazily moving about in their aquarium.

"They're pretty small, too," he said.

"What do you keep 'em here for anyway? They're no good!"

We indicated the labels which, among other things, told of the food value of catfish.

"I wouldn't eat 'em," he grunted, "and, anyway, I always call 'em bullheads."

By this time we naturally were convinced that our exhibits were not exactly approved. The Fisherman turned disdainfully from the minnows and sunfish as though they were far beneath his notice. It was obvious that he was seeking something else. He walked completely around the fish table and then, with an accusing gleam in his eye, asked:

"Where are the trout?"

We admitted lamely that there were no



PLACING HIS MUDDY BOOTS UPON A CONVENIENT TABLE, HE TILTED BACKWARD AND SURVEYED THE FISH COLLECTION

trout in our Museum, due to the lack of facilities for running water necessary for their wellbeing.

"It's a shame!" he exclaimed. "You say these fish are here for the people to look at and you leave out the most interesting one of all. If you only had a trout here, just one little trout, you could get rid of all the others!"

It seemed to us, at this point, that our guest had had his own way long enough. We decided to correct a few of his notions in regard to the general public. "You must remember," we reminded him, "that not everyone is equally interested in the same thing."

"I know about that," he replied "but if you only had a trout here!"

We led the dissatisfied one to another section of the building where there were other live things. He expressed an intense dislike for the snakes and remarked that he did not know one from the other. He seemed rather proud of this.

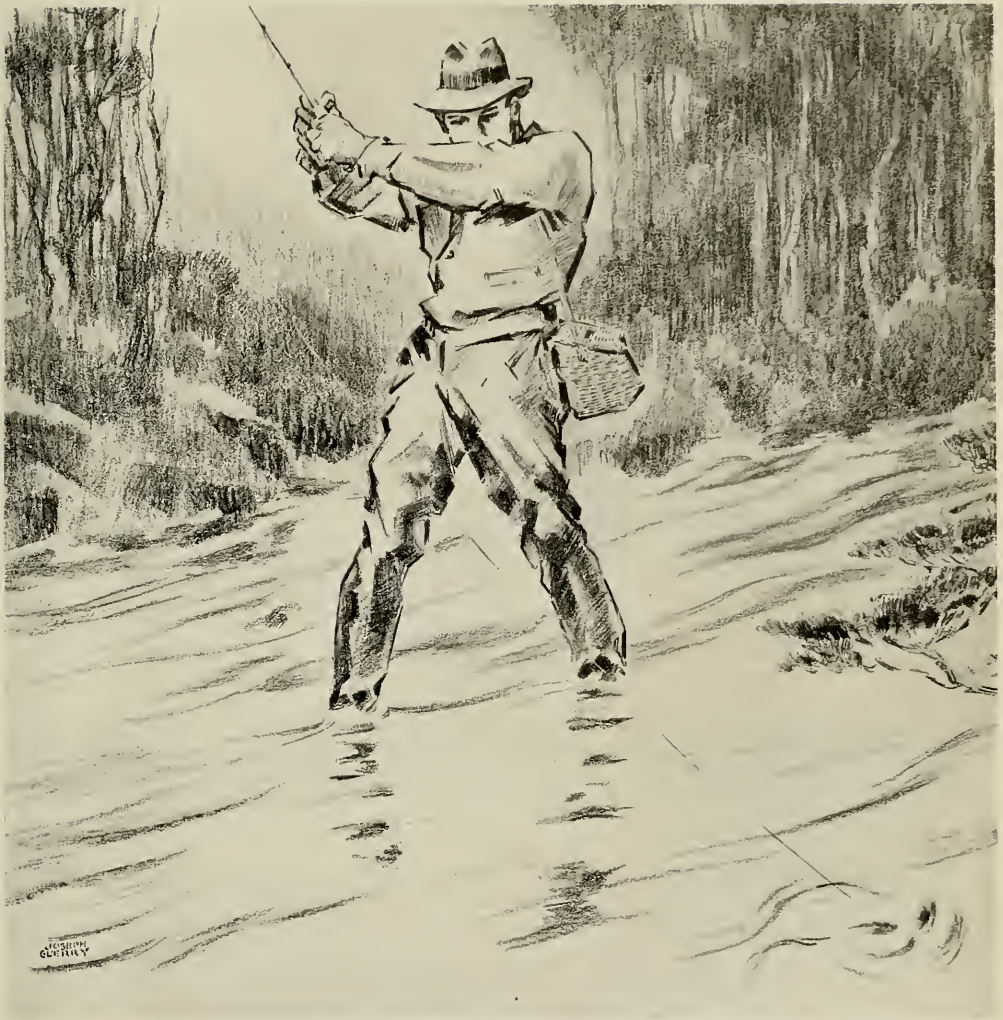
"They're all bad, as far as I am concerned," he said. "Just the other day a water snake on the bank of a brook up in the Catskills nearly scared me to death. It slid down the bank right between my feet and swam away. I almost stepped on it!"

"Oh," we said, "you do know the water snake when you see it!"

We sympathized with him, anyway, and went on to say that we exhibited snakes to inform visitors as to which were harmless and which poisonous. Also we



"WHO WANTS TO HANDLE SNAKES! I DON'T. YOU COULDN'T GET ME NEAR 'EM"



"WHEN I'M NOT SURVEYING, I'M FISHING"

pointed out various charts and diagrams and pictures telling interesting stories of the life histories of various reptiles; how some laid eggs and others did not; how certain ones were decidedly beneficial and could be handled without any harmful consequence whatsoever.

"Who wants to handle snakes! I don't. You couldn't get me near 'em," he continued, as he leaned over the top of the rattlesnake cage with his nose not more than six inches from the screening. "No, sir, I've always hated snakes and I always will."

He moved on to the amphibian table where several species of salamanders were shown.

"Aha," he said, "lizards! I've seen 'em under stones near brooks. They're poisonous, aren't they?"

"No," we answered, "they aren't lizards, either. Lizards have scales; these fellows have moist, smooth skins without any scales at all. They're perfectly harmless."

"I always kill 'em, anyway," was his rejoinder.

We asked him how long he had been a



Photograph by M. Peter Keane

TRAILSIDE INTERIOR

Students from Columbia University make good use of the aquarium tables in the Bear Mountain Trailside Museum



Photograph by Thane Bierwert

PRICKLY PEAR CACTI

Cacti were usually associated with desert regions in the minds of visitors. Many were surprised to learn that a variety of cacti grew in the confines of New York's Palisades Interstate Park



Photograph by Thane Bierwert

REFLECTIVE REFLECTIONS

Two frogs in the Trailside Crafthouse pool rest in the sunlight, to the delight of the Trailside visitor



Photograph by M. Peter Keane

FISH TABLE

A section of the Trailside fish exhibit where catfish, sunfish, minnows, and pickerel were on view. Benches placed beside the table enable visitors to observe and rest simultaneously

devotee of the art of fishing.

"Oh, ever since I was able to hold a rod," he said. "I've traveled in the woods nearly all my life. You see, I'm a civil engineer and I do a lot of outdoor work, especially surveying."

He added that he was married, but that his wife and children saw very little of him.

"When I'm not surveying, I'm fishing," he said.

We realized that golf was not the only game that created sport widows.

The Insect Exhibit, particularly the mounts and the living specimens of dragon and damsel flies and the caddis and stone flies excited the Fisherman's interest. He observed them closely and read the labels through.

"I know all about these," he informed us. "I tie all my own flies; it's the only way to get what you want."

"You know, it's a funny thing," he went on, "how I seem to know only about things connected with fishing; that is, trout fishing. Speaking of insects, I see you've got some hornets here. Well, I had an idea one time when I ran into a hornet's nest. Want to hear about it?"

He looked at us a bit uncertainly, and we at once, and sincerely, indicated that we did "want to hear about it."

"Well, I was up north in St. Lawrence County. Three of us were surveying along the St. Regis River for a power dam. It was a long time ago. Pretty river, it used to be, but the dam and penstock spoiled it at the place we called 'Allen's Falls'.

"As I was saying, we were running a line along the river bank, covering so much ground every day. A boy went ahead cutting brush and we came along with the transit, chains, and rods.

"Saturdays and Sundays, and in between, too, we used to fish some. There were a few good trout in the river. One evening, after a hot day's work through a

lot of heavy brush, we came to a place where the river dropped over a pile of boulders and boiled around and around, makin' some whirlpools. There were a few still places in a little cove, where the foam stretched across. It looked like a good place for fish.

"We worked fast, so's to get back early. I was hurryin' along, ahead of the brush boy, with the transit on my shoulders. All of a sudden, without any warnin', it seemed as though a couple of thousand needles hit me at the same time. I found out later that my transit head, on the end of the tripod, had smashed right into a big nest of hornets. When I looked up and saw 'em sailin' around my face, I gave a yell, threw the transit and all into a pile of brush, and lit out.

"Before I got to the river, they were all over me, down my neck, on my face and arms. It was terrible! The boys thought I'd gone crazy and I guess they were about right. I never stopped, but jumped feet first right into the first pool I came to. The water was almost over my head, but not quite. In I went, clothes and all. Do you know, those hornets kept on buzzin' around, even when I ducked my head! I guess 'twas mor'n five minutes before they gave me up for a bad job. That cool water felt awful good, I can tell you, because I was burnin' up!

"After it was safe, I crawled out, pretty stiff and sore. As a matter of fact, I ran a fever through the night and was sick for a couple of days. But I was going to tell you about an idea I had. You see, we had all figured to fish that evening and I wasn't goin' to stop, stings or no stings!

"After I had sat down awhile, I began to pick dead hornets off and out of my clothes! Then I began to think (that was before my eyes swelled shut) why couldn't I use some of those hornets for bait! Well, sir, I put 'em in a pile and looked 'em over. The boys came up and liked the idea.



"I GAVE A YELL, THREW THE TRANSIT, AND RAN FOR THE RIVER"

The brush boy brought our tackle and we all baited up with hornets. I put one on a small hook and tied him fast with some thread and limped downstream a-ways. It worked. I got a strike almost the minute my hook hit the water! The hornet's wings stuck out sideways and the whole thing made a first-class fly! I've made a few since, but I used bird's feathers and things, instead of hornets.

They didn't work, I don't know why. If you've a few dead ones to spare here, I'd like to try it again. I've never run into any others since that day and I don't want to."

Our visitor was the first and only hornet victim we had ever met who had discovered an immediate use for members of the infuriated host that had attacked him. His persistence passed all understanding.

It so happened that the inverted glass bowls on our Trailside Museum overhead lighting fixtures attracted, among other insects, a large number of wasps and hornets. The fixtures had not been cleaned for some time; thus it was a simple matter to satisfy our guest by removing defunct hornets from beneath the electric bulbs. We were only too glad to learn of something that met with his approbation! The insects were very dry and brittle, though, and we never learned whether the Fisherman was successful with them.

He had thawed out a bit as his story progressed, for, like all men of his brotherhood the world over, he enjoyed an interested and appreciative audience. Once more he stalked over to the snakes and read several labels without criticism. He examined several charts as well.

Finally, we walked outdoors and sat down upon a convenient rock. We knew that, despite the man's somewhat negative response to our Museum, he was really more interested than his speech would indicate. As though to confirm our thoughts, he pointed with his pipe for emphasis, and said:

"Mighty nice place in there. I suppose I could spend a long time looking around and reading the labels. I guess it might be a good thing for me, too."

We agreed, but held our peace.

A catbird, gray, sleek, and bright-eyed, flew down near us and began to scold half-heartedly.

"What's that bird," inquired the Fisherman. "Seems to me, I've seen one before."

We told him about it and added that it was commonly found along the trail. There was a pause for a moment, and then:

"Do you know, I've spent thirty years in the woods, but I couldn't name more than four or five birds at the most. When it comes to fish, that's a different matter. It's pretty hard to stick me about fish!"

"How about your children," we asked, "are they interested in the open?"

"I should say so," he said. "They know more about birds and animals and things than I do—a whole lot more. I guess they get it in school, in the Girl and Boy Scouts. We didn't have things like that when I was a boy; I must bring 'em over here some day."

He smoked his pipe peacefully for awhile and watched the inquisitive catbird. We left him there and returned to the Museum office, realizing that the most important feature of any out-of-door museum concerned the people who visited it. Several moments later we looked up, and there was the Fisherman.

"Have you any books for sale about snakes," he asked?





A Mountain Trail That Follows a Dry River Bed

FROM SEA BOTTOM TO MOUNTAIN TOP AT SANTO DOMINGO

A Search for Strange Creatures Above and Below the Sea in the
Most Diversified Island of the West Indies

By WILLIAM G. HASSLER

Department of Herpetology and Experimental Biology, American Museum

PHOTOGRAPHS BY DANIEL PEASE AND WILLIAM HASSLER

NOTE.—*The participation of Mr. Hassler in this expedition was made possible through the generosity of Mr. Lorenzo D. Armstrong.*

A PLANE WILL BE WAITING TO TAKE YOU TO BARAHONA. PLAN TO CARRY ONLY NECESSITIES. YOUR OTHER THINGS WILL BE TAKEN BY SCHOONER."

Such was the message which awaited us at Puerto Rico when our steamer docked there the day before we were due at Santo Domingo City. What a surprise and what a change in our plans! It is some hundred odd miles by road from the capital of the Dominican Republic to Barahona, our headquarters to be, and this distance we had expected to cover by automobile. In fact, in our plans for that trip we had counted on using two old Fords or other similar light cars, one for ourselves and one for our luggage, and had visions of bumping along the road for eight or ten hours. But to fly over

that country—that was something of which we hadn't even dreamed!

Twenty-six hours later we were beginning our first flight over that second largest, yet wildest and most diversified island of the West Indies. Forty minutes from the time we left the capital we were roaring over a range of mountains which at that point dropped as sheer cliffs into Neiba Bay. The varying colors of the water clearly indicated the reefs and shallows, soon to be plundered by two of the members of the expedition. The plane, however, gave us little opportunity for prolonged observations. The buildings of the Barahona Sugar Company and the tall brick chimney towering above the mill were rapidly becoming larger. Suddenly we swooped over the *Central* and a



"BATEY CENTRAL"

The mill, offices, hospital, and homes of many of the workers form the "*Batey Central*" of the sugar company. On the left of this picture, taken from the mill roof, may be seen the edge of the mountains where part of the field work was conducted

moment later were rolling down the diminutive and bumpy air-field at Barahona. This convenient way of making the trip was one of the many things which the officials of the sugar company kindly arranged for us.

A week later we were not only settled in one of the comfortable bungalows at the *Central*, but the large living-room had come to look like a combination laboratory and museum. On the walls hung maps, blue prints, and a barometer. In one corner the cabinet which should have contained china and glassware held, instead, things entirely foreign to it. One shelf supported a number of jars filled with preserved crabs, fish, and lizards! On another were pieces of coral and shells spread out to dry and several magnificent sea urchins with their slender black spines protruding some ten or twelve inches in every direction and forming a very respectable defense. Still another shelf held pieces of wood to which

were attached small white objects—the eggs of certain lizards. The sideboard, too, contained specimens and scientific instruments instead of silverware.

But occupying most of the room was the table, a rough plank affair nearly fifteen feet in length. On it was a strange array of jars, boxes, trays, a microscope and other instruments and scientific equipment, which clearly reflected the interests of the four members of the expedition. Crabs, fish, and mollusks, together with sponges and corals, filled much of the otherwise vacant space at one end of the table as they lay in trays or stood in bottles. The flash of bright colors in the middle of the table indicated a newly caught series of butterflies, not yet removed from the cyanide bottle. Beside these lay two or three wooden boxes containing many Lepidoptera already packed carefully away, with space for many more to come. At the other end of the table stood two jars, in one of which a long and slender

bright green snake was neatly coiled, and in the other were several small frogs, two stout and puffy toads, and half a dozen lizards, all preserved in formaldehyde. Beside these stood two large cans, some note books, and a string of small lead tags.

What had been the kitchen of the house was piled up with spare nets, heavy dredges, trunks of extra jars and other as yet unused equipment. Even outside on the porch was a rapidly growing collection of corals, huge star fish, and other creatures from the reefs, left there to dry.

Field work began almost immediately after our arrival at Barahona. The Dominican government and its officials had been very helpful and we experienced no delay in getting our equipment through the customs, or in securing the necessary

permits to use firearms to collect specimens which were too elusive to be caught by other means. Mr. J. C. Armstrong and Mr. D. C. Pease, who had first planned the expedition for the purpose of increasing their collections of aquatic life, were daily bringing in interesting, and sometimes quite rare marine specimens. Each morning they would leave the house loaded down with water glasses, nets, bottles, milk cans for specimens, and other equipment. Sometimes at noon, when they returned to the company's dining hall for lunch, they would be fairly staggering under the load of the morning's collections. Immediately after lunch, these specimens would be temporarily fixed, and then off they would go to spend the afternoon working in some other location.

In the meantime, Mr. W. M. Bush was



THE EXPEDITION'S HEADQUARTERS

This fine bungalow at the "*Batey Central*" was placed at the disposal of the expedition by the Barahona Sugar Company and made an admirable base during the several months of field work in the vicinity



DRYING SPECIMENS

The side porch of the expedition's headquarters was used as a drying place for the corals, sponges, and sea-fans that had been collected

busy making a systematic collection of the Lepidoptera to be found in the neighborhood of Barahona. The region is semi-arid, and back from the coast, where not artificially cleared, much of it is covered with a rather dense growth of thorn trees and other scrub vegetation. However, it does not lack either numbers of species or individuals. Many gorgeous butterflies flitted along the forest trails and enticed the collector, but myriads of bloodthirsty mosquitoes also made these their hunting grounds and, for any kind of comfort, necessitated the wearing of a head-net and sometimes even gloves, really a rather incongruous and uncomfortable outfit for a butterfly hunter.

Reptiles were not uncommon either, but for the most part they were typical species to be found in any of the drier regions of the island. It was back in the mountains that I hoped to find new and

interesting forms. The ever-present Anoles bobbed their heads from nearly every tree and snapped up flies from the window screens on the houses. Some of these I tagged with tiny pieces of adhesive tape and then recorded their movements thereafter, thus securing notes on their actions and habits. Another species of lizard, about which we had previously known very little, obliged us by living in the trees of the *Central*. Thus it was easy to secure its eggs and a series of the quaint creatures alive to send to the experimental laboratories of the American Museum.

The long, slender, green snake, coiled in the jar on the table, was not only from an aboreal genus but must have been particularly "air-minded,"—it had been presented to me one morning by "Tex" Anding, the pilot, who had found it in the cabin of his plane!



EMPTYING THE DREDGE

The dredge, a bag of strong netting with a heavy metal frame and scoop at the mouth, has just been brought to the surface and is being emptied into a tub. This is usually a most exciting moment

Toads and frogs made their presence known at night when they congregated in the little puddles which formed under leaking faucets beside the houses and on the lawns. There they would squawk and trill, probably to their own enjoyment but not to that of any one else at the *Central* as far as I could learn. But their calling seemed to be having the desired effect, for many of the puddles also contained the offspring of those noisy, courting males!

While the frogs sang and dances were held at the native houses, our evenings would be spent identifying the day's catch, carefully preserving and labeling it and writing up the detailed field notes. Often we would have visitors at that time. One of the older native boys, a deaf-mute, frequently came and stood outside our windows. He would stand quietly for a



A FIELD LABORATORY

On a long table was grouped the particular apparatus that each of the four members of the expedition used in his special field



SORTING A CATCH ON THE DREDGE TABLE

After the bulkier material has been removed from part of a dredge load with a coarse screen sifting-tray, the sand and mud are washed off, and the smaller specimens are sorted on the lower, fine screen tray of the table

few minutes, absorbed in watching us work, then, unable to contain himself longer, would attract our attention by scratching on the screen and break into an animated conversation over the size, edibility, where caught and method of capture, or some other point in connection with the specimens. He used a sign language of his own which was surprisingly clear and comprehensive and often amusing. Some of the men of the sugar company also took to dropping in to see what new things we had found, and to discuss the fauna and other interesting characteristics of the region. They were always welcome and we learned much from them. In fact, the coöperation of these men was a very important item in making our stay enjoyable and our work successful, and we wish to take this opportunity to express our gratitude.

Four weeks after our arrival we brought



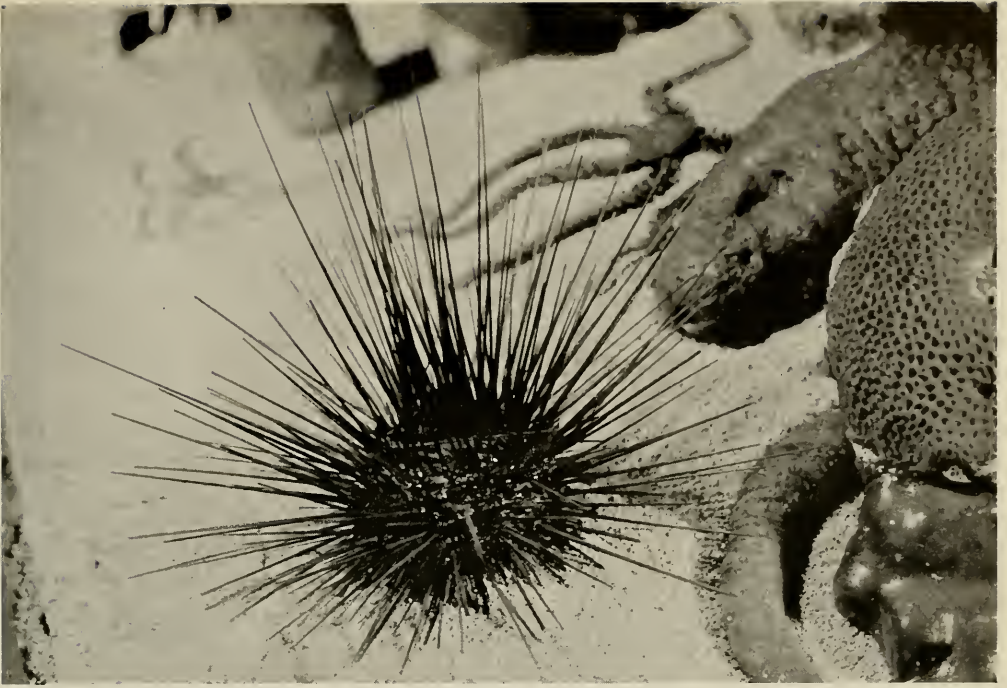
NOT TINY FIR TREES, BUT MARINE WORMS

These pinkish-colored plumes, an inch or two in length, are "coral worms." The branchlike structures are modified processes which assist chiefly in respiration. When disturbed, the worms withdraw into the tubes which they construct in the coral heads and close the openings with disc-shaped operculums, as one has done in this picture. (Detail of a group in the American Museum)



A SMALL ASSISTANT LENDS A HAND

Performing autopsies on two iguanas to try to determine the cause of their death. The children of the *Central* were frequent and interested visitors at the expedition's headquarters



A PORCUPINE OF THE REEF

These long-spined sea urchins are unpleasant fellows with which to come in contact, since the spines pierce the flesh very easily and then break off in the wound. They were very numerous on the reefs, but long trousers and crepe-soled sneakers offered some protection to the marine workers. (Detail of a group in the American Museum)



HOLDING A HALF-GROWN IGUANA

Armed with powerful jaws, sharp claws, and muscular tails, these lizards are hardly gentle playthings. Iguanas have sometimes been kept in the sugar warehouses to kill the rats



A "WELL" NEAR TRUJIN

At Trujin the expedition's drinking water came from a pool at the bottom of this small cave. The water was slightly brackish and was inhabited by several large crabs and countless tiny crustaceans

our work to a close near the coast in preparation for a series of interesting inland trips. Besides collecting by hand on the reefs, using fish traps, nets, and small dredges, and buying occasional specimens from the native fishermen, Mr. Armstrong and Mr. Pease made use of a large boat to draw their heavier dredge and tangles. The two men who handled the boat had no idea of the proper manipulation of a dredge and this often brought about amusing and awkward situations. The dredge frequently caught on rocks and isolated coral heads and sometimes only after a long struggle could it be freed, to come to the surface wrenched and mangled, its frame twisted and its bag ripped. After successful hauls, when the mud from the bag was sifted away, innumerable small mollusks would appear, together with strange crustaceans having

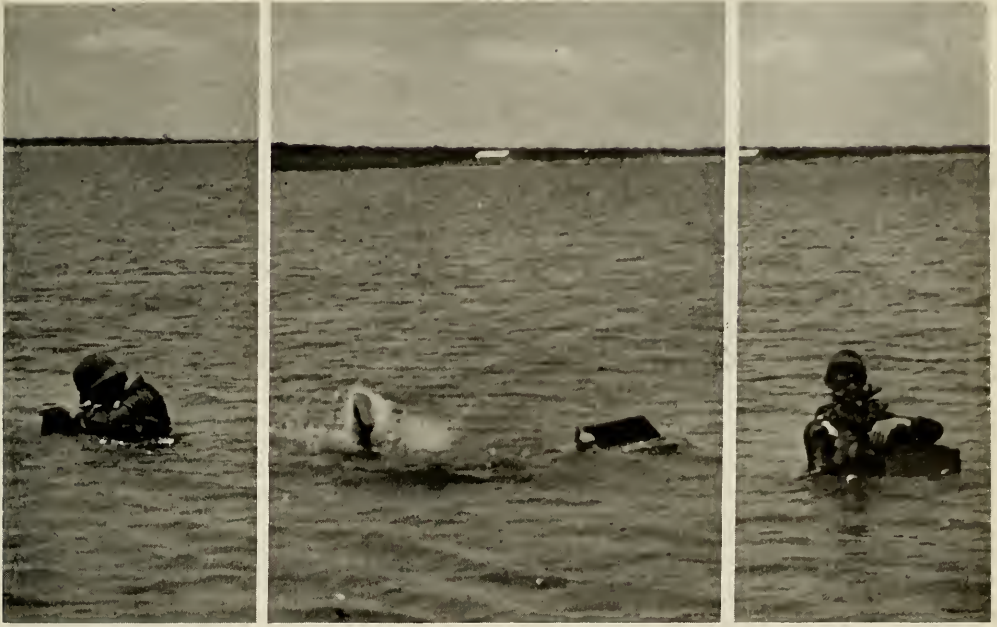
long spines, heavy claws, or enormously long legs; also delicate, though usually shattered, echinoderms, small fantastic fish and brilliantly colored worms, some, most unwormlike in appearance. Occasionally the dredge would catch in a native fish trap, because these huge affairs are often anchored without a marker, to prevent pilfering. The results of their work, although not exhaustive of the possibilities, were nevertheless satisfying, including as they did many forms new to the region and some rare or even unique in any collection.

The reptile business, too, had boomed. The statement that we would like one or two live iguanas had borne fruit nearly a hundred fold! Almost without warning they started to pour in from the natives in the cane fields, and one of the field managers found his back yard rapidly becoming a stockyard for the beasts.



RAIN FOREST ON A MOUNTAIN TOP

Growing above Mr. Hermann's finca, at 2400 feet, this dense tangle of tree ferns, slender palms, and liana-draped trees, was a rich collecting field



COLLECTING IN SHALLOW WATER

The left-hand panel shows Mr. Armstrong using a water-glass to locate specimens. In the center, a kicking foot and hand grasping the glass indicate his descent. At the right he is holding the prize, a branch of coral

Several times Mr. Davies came in with the rear of his car fairly bulging with burlap sacks filled with iguanas. Mr. G. H. Hamor, Field Superintendent, who supplied the original initiative and started the wheels turning in the iguana business, I suspect secretly enjoyed our difficulties as each new load came in. At first we tethered the animals with rope to heavy screw-eyes placed in a row along our porch. The fact that our slumbers were often broken by the scratching of powerful claws and the thrashing of heavy tails was part of the price we paid^e for that first rash statement. When our porch could no longer accommodate more, we tied them up in an unused chicken coop. Finally in desperation we called a halt! Forty of the brutes had come in to us and we later learned that, upon our refusal to purchase more, nearly a hundred, which were being held in outlying settlements, were turned loose again. Of those forty, a few escaped and a few others

died from injuries received during their capture, for the natives generally use dogs to run down the lizards. As it was, thirty of them, ranging in size from eighteen inches to nearly four feet in length, were crated and sent to the Museum.

Mr. Bush, too, had been busy. Besides working in the immediate neighborhood of the town and *Central*, he had made a short expedition to the cane fields and there added many more specimens to his collection. Among these were a number of butterflies of a species which he had not found nearer the coast. The low, flat country thereabouts is hot and dry, cane-growing being made possible only by extensive irrigation. His collecting also took him beyond the cane fields, where to the west stretch miles of uninhabited wastes, once part of the sea-bottom and still too salty to support more than a desert-loving flora. A thermometer laid on the sand out there for a few moments registered



FROG COLLECTING DRAWS AN AUDIENCE

In a coffee pickers' settlement high on a mountain-side, an old water tank harbored a number of large tree frogs. However, for some strange reason the native boys here held the amphibians in great fear and could hardly be persuaded to touch them

Armstrong and Mr. Pease were able to collect a series of fossil marine forms. From there we went back to Lake Rincon, reaching the town of Cabral at dusk with the automobile seemingly on

146 degrees Fahrenheit! However, the greater part of Mr. Bush's time was spent in the immediate vicinity of Barahona, in order to collect in one locality as long as possible. In this way, over a period of six weeks, his collection of the forms to be found there was quite complete.

Our first inland trip was to Lakes Limon, Enriquillo, and Rincon. Limon proved to be unbearably hot and a poor collecting place. The lake is about five miles in length, has slightly brackish water, and is shut in on one side by high mountains and on the others by low hills. We stayed there a day, doing a little collecting and a great deal of perspiring, and then returned to a beautiful palm grove near Lake Enriquillo, where we remained another day. There, walking about on what had once been the floor of the ocean and which is still below sea level, Mr.

its last legs—or wheels. After some discussion, we rented a good-sized house and made ourselves at home. Our arrival, of course, was the signal for most of the village to turn out and inspect us, so our audience was no small one when it came time to prepare supper on one of the charcoal braziers so commonly used in the country. This was our first experience with one and probably we were amusing. Certainly the crowd of boys who clustered just outside the doorways thought so as they remarked on our every move and begged for the empty soup cans. Our collecting activities were a source of interest to everybody, as usual. Fish



ON THE WAY TO THE LAKE LIMON

Heavy rains in the mountains frequently cause the small streams to rise rapidly and overflow their banks, turning the roads into ponds and making travel over many of them quite an adventure

TAKING ADVANTAGE OF
CALM SEAS ON A REEF

After the wind comes up, the surf breaks over Piedra Prieta Reef, but in the early mornings it proved to be a very satisfactory collecting ground. Weird little crabs, brightly colored snails, brittle stars, and marine worms, all live under these rocks

and a few fresh-water turtles were taken from the lake which is actually formed by the overflowing of the Rio Yaque. This collecting was done from crude dugout canoes which are used by the fishermen on the lake.

Our next trip was quite different. It was to the mountains near Barahona and we found the cool air a great treat after a month of the heat near the coast and especially that of our recent experience below sea level. Señor Manuel Mella Del Monte, manager of the Del Monte coffee finca, not only graciously gave us permission to stay at the finca but accompanied us there himself and saw to it that we were comfortable in the main house. The two marine enthusiasts turned their attention to land snails and fresh-water crabs, while I searched for whatever reptiles and amphibians the forests and coffee groves



hid. Our efforts were quite successful and yielded many forms entirely different from those found in the lowlands.

One morning, while high on the mountain side, our attention was attracted to someone calling over and over again in a high-pitched but cheery voice. A few moments later a Dominican boy of perhaps fifteen came rapidly through the trees and approached a stump where he thrust a pole into a crevice and repeated his sharp calls. They were answered almost immediately by three mongrel dogs which came running up and began a furious digging at the base of the stump. Suddenly there was a scramble and one of

them was shaking a rat. With a laugh the boy whipped out his machete and severed the rat's tail just as it was disappearing down the dog's throat. Then he carefully deposited the tail in a bag which was slung over his

COLLECTING TAKES TO
THE HIGHER BRANCHES

One of the fascinations of field work is studying the living animals in their own haunts. Mr. Armstrong and Mr. Hassler are searching for small arboreal lizards and their eggs



THE TERMINUS OF AUTOMOBILE TRAVEL ALONG THE COAST

A rough but passable road at present extends south about eleven miles from Barahona to the quaint and typical village of La Cienega. Work is progressing, however, on an extension which in time will make it possible to continue by car for many more miles down the coast



COOKING BREAKFAST ON A CHARCOAL BRAZIER

There is a knack in cooking on an "anapha." Frying bacon for breakfast was simple enough, but to balance the soup, coffee, rice, and beans presented a very real problem

THE COAST NEAR PARADIS

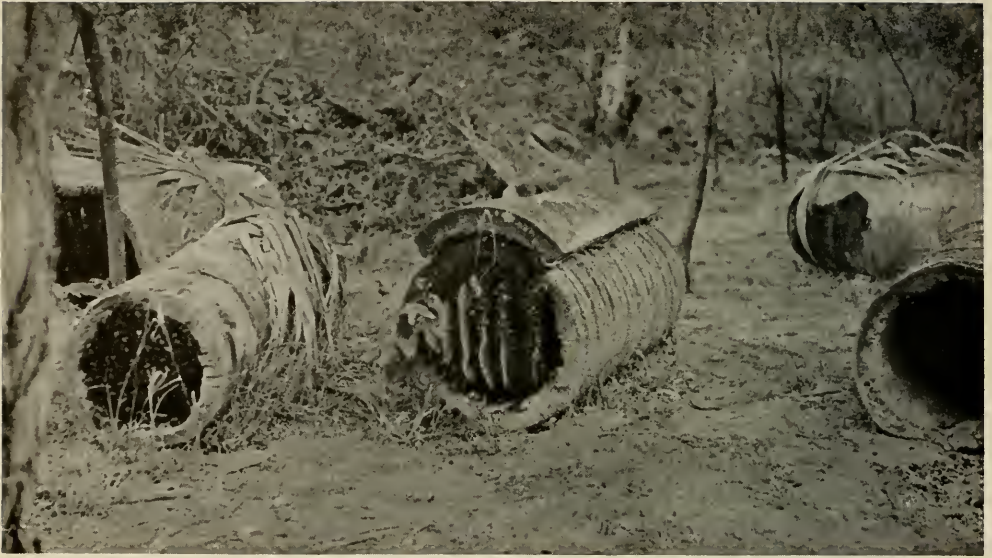
The huge rocks on which the men are standing were once parts of caves which had fallen in. From these perches the men were fishing with hooks and lines, and, among other forms, were catching small tarpon



A FISHERMAN AND HIS DUGOUT ON LAKE RINCON

When a rain storm came up, this man, in order to keep his meager clothing dry, removed it all and carefully rolled it in a large water lily leaf. Lake Rincon is thickly grown with weed and so shallow that poling is the means used to propel the dugouts over most of its sixteen or so square miles of surface





NATIVE BEEHIVES

The trunks of trees are hollowed out for hives. In this case sections of palms about three feet long have been used, and the edges of the combs, almost covered with bees, may be seen. At one time the Dominican Republic exported quantities of honey, but now there is little demand for it.

WHEN "SMILE, PLEASE!" WAS
UNNECESSARY

Children, enlisted as collectors, brought in many specimens. This child has just presented a small lizard and awaits her reward.

shoulder. Upon inquiry we found he was the official rat catcher of the finca, receiving the sum of seven dollars a month with food and clothing! Once, when Mr. Pease, who had gone down along a stream alone, failed to return when we expected him, we sent the rat catcher out to see if anything had happened. Soon after he left, the missing explorer returned. Five minutes later the native boy came back to report that he had trailed him all the way down and back through the woods, and as evidence he offered a dozen or so of the empty .22 caliber shells which Mr. Pease had ejected from his pistol from time to time as he shot wary lizards for specimens!

But there were other places we wished to visit, so at the end of that week we left "El Propio Esfuerzo" and returned to Barahona with many more specimens to add to our collection.

Well-known and well-liked by most of the people throughout the region was a spry old German coffee planter. Keen

about any branch of science, Mr. Herrmann had soon learned of our first arrival at Barahona and had invited us to visit him at his finca. It was a trip to which we looked forward, for his description of the mountains about his home was alluring. Therefore, early one morning we slowly and erratically made our way down the coast in an old sailboat equipped with a dilapidated automobile motor. It was the last trip for the other members of the expedition, for, following their return from Herrmann's, they would have to pack and return to the States. Moreover, we were all together, as Mr. Bush was accompanying us on this trip.

Our ensuing visit at Herrmann's was most enjoyable and profitable. In the dense forests on the top of the mountain above his finca we found many interesting frogs and some rare lizards. On the mountain and in the river valley below, Mr. Bush found several interesting species of butterflies, including a single specimen of a Castnid moth, endemic to



MAKING CAGES IN WHICH TO SHIP
IGUANAS

The powerful lizards were sent to the American Museum in large boxes half-filled with dry grass and covered with heavy screen and slats



CALLING FOR A MATE

Locating frogs at night by their characteristic calls and then studying them by flashlight is a most interesting as well as profitable method. This "barking frog," squatting in a crevice in a log, was photographed with his throat expanded as he was in the middle of his song

this island. Meanwhile, Mr. Herrmann, who is thoroughly familiar with most of the region, furnished us with such interesting descriptions of the country to the south that Mr. Armstrong and myself were influenced into taking a three-day trip to see it for ourselves. For about twelve miles south of Paradis the mountains crowd close to the sea, but beyond that they recede and give way to a nearly flat landscape. Of particular interest was the large salt lagoon of Trujin, near the village of that name. We learned that there was a flamingo colony at the north end of the lake but were unable to visit it in the short time at our disposal. We did, however, find ourselves back in the iguana business again! Returning from a tramp which took us along the shore of the lake and to some caves in the low hills, we found a group of natives waiting for us, and lying on the ground beside them were two large iguanas. In fact, one of them was larger than any which had been brought to us at Barahona. Next day we returned to Herrmann's with the beasts carefully trussed up and tucked in the panier on one of our mules.

In the meantime things had been happening during our three days' absence.

The coffee pickers had started bringing in specimens and Mr. Pease had had his hands full caring for them. Bags were hung around the room to keep possible rats from dining on the contents which consisted of literally dozens of snakes and lizards. There were small glossy brown lizards called "*Rana lucias*" and the large "*Salta cocotes*"; there were small snakes and large snakes, while a box in the corner held some which were too heavy to go in the bags. These were "chicken snakes," a form of West Indian boa which grows to about six feet in length and nearly two inches in diameter! They seemed common in the mountains and seven had been brought in.

But Time moves, even in the tropics, and that which Messrs. Armstrong, Bush, and Pease had at their disposal was rapidly drawing to an end. I was fortunate in being able to stay a little longer in order to make additional collections and studies in some other places in the region, but the others had duties which prevented their remaining longer. Thus, while we were still at Herrmann's, the morning came when good-byes were said and they took the trail down the mountain and back to Barahona and the States.



EL LAGO DEL LIMON



THE CUTTING
TACKLE OF A
WHALESHIP

FLOATING GOLD

The Romance of Ambergris

IN TWO PARTS—PART II

By ROBERT CUSHMAN MURPHY

Curator of Oceanic Birds, American Museum

DEDICATED TO THE MEMORY OF FRANK WOOD, CURATOR OF THE WHALING MUSEUM,
NEW BEDFORD, MASSACHUSETTS.

BUT what of the actual value of ambergris in the open market? This, as hinted in Part I, ranges rather widely, in tune with the law of supply and demand but, in general, high grade lots fetch from \$14 to \$20 an ounce. If you are lucky, therefore, your find may be literally worth its weight in gold. In 1898 a London merchant had a lump weighing 270 pounds, which was sold in Paris for 85 shillings per ounce, or £18,360. A copy of the *Boston Ledger* of the year 1859 records the largest known haul—a lump weighing 750 pounds, all taken from one whale by the crew of a Nantucket ship. The account goes on to say that the largest quantity known to have come from a single whale up to that date weighed 182 pounds. Since that time amounts varying between 60 and 200 pounds in weight have been taken

from the carcass of one whale, or have been salvaged in the form of single concretions on the sea or shore. The total production in the United States during the last year for which I can find data (1922) was 44 pounds. This was all landed at New Bedford, and brought only \$11,000.

Fine ambergris in the form of flotsam has come into the trade, as well as that "untimely ripped" from whales, but as to whether the floating supply has been discharged by living carriers, or has survived the decomposition of dead whales, later to be buoyantly resurrected from the depths of the sea, we have no means of knowing. The Bahamas are a famous collecting ground on the American side of the Atlantic, and it is significant that the pilot charts show no less than three "Ambergris Cays" in the romantic waters of the Spanish Main.

The early history of Bermuda is also bound up with an ambergris yarn. When Richard More, the first governor, arrived in 1612, he found that three shipwrecked mariners had concealed a large quantity of drift ambergris in lumps weighing fifty pounds or more, which they had plotted to transport secretly to England. The governor seized the treasure in the name of the Virginia Company and the ambitious sailormen all but came to the gallows. The record contains the following warning to His Majesty's representatives:

As touching the findinge of Ambergreece upon the shore which is driven up by every storme where the wind bloweth, we would have you remember that by such as you appointe to that business, you may be deceived of the best and fayrest except you be very carefull in your choice of honest men.

Strange stories of finds, some apocryphal and some with a basis of truth, have been set down in countless scattered publications. One tells of a chunk of ambergris that during many years formed part of a flower-covered rockery in a New Zealand farmer's garden. When the nature of the "rock" was discovered, it sold for four pounds five shillings per ounce. In Barbados, so runs another circumstantial yarn, a market-bound black girl lowered a basket of live poultry from her head, and sat down to rest upon a rock on the beach. She presently found that her cotton dress had stuck dismally to the rock. An apothecary learned of the incident and garnered a block of the best gray ambergris weighing 1400 ounces, which brought him five pounds ten shil-



Courtesy of Colgate-Palmolive-Peet Co.

AMBERGRIS IN A PERFUME LABORATORY

Two chunks, weighing eight pounds, lie on the table. The raw ambergris is ground in a mortar, added to 95% alcohol, and allowed to soak for six months or more, after which the tincture is filtered and introduced into fine perfumes



ROCKING THE WINDLASS

On the topgallant-forecastle, to the strains of "Blow the Man Down" or some other merry chanty, the crew of the "Daisy" apply the man-power which rips the blubber from the whale

lings per ounce. Similar tales have come to my attention from Japan, Hawaii, Madagascar, Morocco, Brazil, Ireland, and the Persian Gulf. Finding ambergris is almost in the nature of an ethnic tradition!

Because of the fanciful nature of most of the yarns about drift ambergris, modern chemists and dealers are even more skeptical than is warranted by the extreme rarity of finds. Some go so far as to say that the substance has never been discovered anywhere except in the bowels of a sperm whale. The best answer to this is the fact that ambergris was valued and trafficked in centuries before man had captured, pictured, or even become acquainted with the sperm whale. Ambergris is an ancient treasure; its source is relatively new knowledge. It may well be that most of the free supply is long since exhausted; it is certainly true that practically all the contemporary finds

prove to be false alarms. Yet I hold that there is still justification for keeping a weather eye open.

In view of the marvelous accomplishments of modern chemistry, it is to be wondered at that no enterprising worker in a perfumer's laboratory has yet solved the fundamental problem, as has already been done with regard to musk and otto of rose. If a synthetic ambergris should be devised, the bottom would at once drop out of the market for the natural product. My humble suggestion to anyone with ambitions in this direction is to go back of the whale and start experiments upon the fat contained in the bodies of the abundant squids, octopuses, or other mollusks of the group that zoölogists call cephalopods. Here, beyond a doubt, the ore of the floating gold must lie. Squids are excellent human food, as you may find out for yourself in the Spanish or Italian restaurants of Ameri-



SPOUT'S END

A fraction of a second before this photograph was made, the tropical air was blurred with misty breath from the nostril of the still rising sperm whale

of the terrible lance, thrust and "churned" by the mate, evidently found its life, for the whale went immediately into a flurry, swimming desperately around the boat, and rolling over and over so that the line encircled it many times.

can cities, but as to whether our own digestive juices turn any part of them into a silver or golden lining we hardly stop to consider.

Unimaginable numbers of squids, which occur in practically all parts of the oceans, are devoured by sperm whales. The certainty of this is, of course, obvious from the bulk of the mighty foragers and the size and number of the schools engaged in an unceasing quest for food throughout all the warmer sea waters of the globe. It was indelibly impressed upon my mind, however, by an incident witnessed during a South Atlantic cruise in the old New Bedford whaling brig "Daisy." I manned stroke oar in the mate's boat, and on one occasion our harpooner made fast to a medium-sized sperm whale, perhaps thirty-five feet in length, which showed very little fight, and which we overtook soon after the iron had been planted. The first pricks

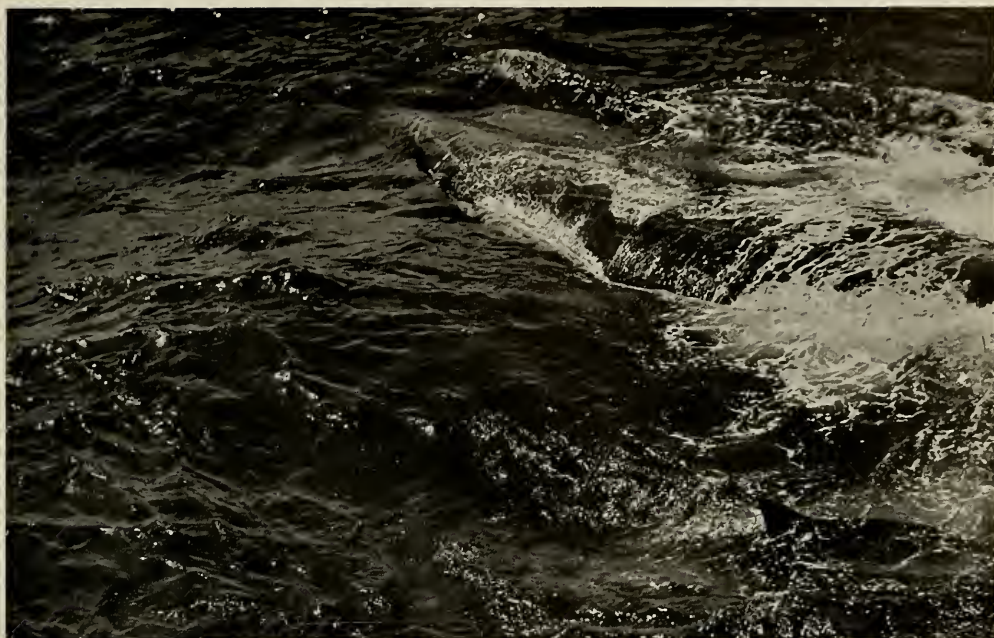
Then, while we watched its dying struggles at close range, the beast began to belch up squids. Barreiful after barreiful of the tentacled creatures, some but freshly swallowed, others in advanced stages of disintegration, floated to the surface all about our boat. Most of them seemed to have bodies a foot and a half or two feet long, but some were larger. By the time the whale floated fin-out and lay still, the slimy carcasses and fragments of squids covered the space of an acre or more.

Eleven months in the "Daisy," and participation in the exciting slaughter and subsequent butchery of twenty-seven



LAST GASP

The sperm whale from blow-hole to hump. Air is being sucked into the dilated nostril just before the snout rolls under the blue sea



THE SWIFT CALL OF OCEAN'S CARRION

Beside the whale's hulk, the slender form of a blue shark (*Prionace glauca*) may be traced from sharp nose to back fin, which projects above the water, and then on to the upper lobe of the tail

sperm whales, never brought me, alas, the thrill that may not come even once in a lifetime—a find of native ambergris. The search was made in every whale, as the final stage of the cutting-in, but it seemed to be a half-hearted effort, the expression of a forlorn hope, much as though you should scan the gutter along twenty blocks of Broadway in a deliberate, cold-blooded hunt for a five-dollar bill that somebody might have lost.

I remember particularly one vast but scrawny bull, the blubber of which contained much less oil than his size had promised. If the tradition of the sea is correct, he was a typical "ambergris fish." The cutting-in went on from mid-afternoon until well into the night. The "Daisy," with topsails aback, rolled gently in the quiet swell of a tropical evening, while the officers on the cutting stage punched with their spades as best they could in the dim light of lanterns and oil-soaked torches. The flickering glare

showed the indistinct hulk of the whale alongside, and the flash of bloody wave-lets beyond. On deck a cresset of burning blubber-scrap, and the fiery chimneys of the try-works in full blast, cast enough illumination to reveal the great blankets of blubber and the greasy, toiling figures scurrying about, amid the shouting of orders, the creak of tackles, and the clank of chains. At six bells the last strip came over the plank-sheer. The severed head floated by the starboard quarter, lashed securely and ready to be handled at daybreak. Only the rite of the whaleman's ultimate hope remained to be carried out before the flensed carcass should be cut adrift.

The Old Man joined his officers on the cutting stage. Then, with methodical movements, he and the three mates thrust freshly sharpened cutting-spades deeply into the guts of the whale, twisted them, cautiously withdrew them, smelled the bright steel blades, and scrutinized



OFFICERS' WORK

The three mates of the brig "Daisy" cut a spiral scar through the blubber of a whale so that the windlass-workers may tear it from the carcass



"THE OLD MAN"

Capt. Benjamin D. Cleveland of New Bedford, master of the brig "Daisy," shoots the sun with his sextant during a noonday calm

THE NAVIFAUNA

Above the piglets projects the tip of an ivory-toothed sperm whale jaw, eighteen feet in length, lashed to the gunwale of the "Daisy"



THE BLUBBER PARLOR

Down through the main hatch the great blanket pieces of blubber are lowered, and between deckmen with short-handled spades cut them into smaller blocks



them painstakingly in the light of a lantern, while the crew looked on in fevered anticipation. Back and forth along the stage the four men trod and jabbed, until the vitals had been intimately explored. But nary a whiff of the longed-for odor was forthcoming, and so to bed.

My hard old skipper, God rest him, was part owner in another vessel engaged in sperm whaling during the same period, and this craft, the schooner "Whyland," took nineteen pounds of ambergris off the coast of Africa. When we on the "Daisy" learned the glad tidings from a third whaler, at Barbados, the Old Man expressed himself characteristically.

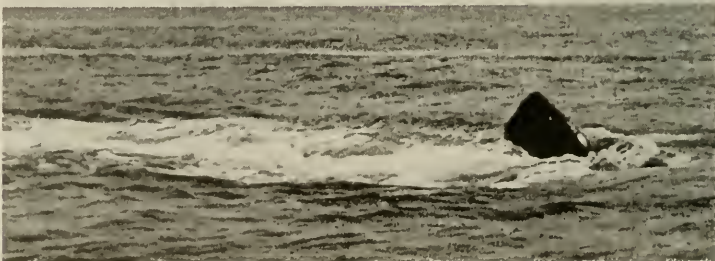
"Very poor quality," he announced; "black, and full of impurities."

I am morally certain that he also wrote post-haste to his agents in New Bedford, belittling the whole matter and minimizing the amount. Inflation of stock is the wrong tendency in the ambergris game, and Captain Ben Cleveland was a past master at doing just the opposite. Subsequently, when both the "Daisy" and the "Whyland" had moored in the home port, ten pounds of good ambergris were advertised and disposed of. About a year later, nine additional pounds were sold, to the compounded benefit of the owners and the fortunate crew. Catching your ambergris is really only half the trick.

In Part I of this article, I remarked that of forty prospectors who have

done me the honor to seek me as a gratuitous consulting expert, thirty-nine were duds. The other was a man from Alaska, a middle-aged, short, capable-looking chap, perhaps a mining engineer or something of the sort. His tiny sample looked right, and the lens and test-tube verified it. He said he had about thirty-five pounds more, and his story was a fantastic one, as befits the subject. Strolling along a beach near Nome on a Sunday afternoon, he had startled a wolf in the act of eating a large chunk of carrion at the water's edge. The animal beat a retreat, with its belly sagging, and inspection of the material that it had left aroused enough suspicion in the mind of my caller to make him gather it up, say nothing, and lug it all the way to New York. He was so well prepared for what I told him that the verdict brought only a slight increment of satisfaction. I remarked that although some philologists held that the word ambergris came from the same root as ambrosia, the food of the gods on Mt. Olympus, there was no precedent that would justify its use as a diet for predatory carnivores! I advised the man what to do with his supply, neglecting to ask his name, and I have neither seen nor heard of him since.

"To think," was his parting comment, "if I'd been ten minutes sooner that damned wolf wouldn't have cost ~~me~~ a five-thousand-dollar meal!"



SPERM WHALE IN A FLURRY, "JUNKING UP"



Artist's Sketch of Successive Explosions of a Meteor. By T. W. Voter

COMETS, METEORS, AND METEORITES

Mysterious Travelers of the Sky—Their Origin, Action, and Composition

BY CHESTER A. REEDS

Curator of Geology and Invertebrate Paleontology, American Museum of Natural History

COMETS, meteors, and meteorites are usually regarded as three distinct cosmic phenomena. They seem to be connected, however, by relations of origin and association founded upon well authenticated observational evidence. These phenomena appear but occasionally and are singular and mysterious in aspect. In appearance comets and meteors resemble one another, for they both have luminous heads and nebulous tails, but as far as space relations are concerned they are separated by millions of miles. Comets, which are the most distant, are those erratic members of the solar system which move in elongated orbits about the sun. Their masses are exceedingly small when compared to their size, for they are generally surrounded by hazy or nebulous envelopes. Meteors, on the other hand, are transient cosmical bodies which enter

the earth's atmosphere from without and become luminous as they shoot across the sky. Meteorites are masses of matter from outer space which have fallen upon the earth's surface. They consist usually of stony matter with varying amounts of metallic iron and nickel; more rarely of nickeliferous iron and much more rarely of stony matter with little or no metal.

For untold centuries man has looked at the starry canopy of the heavens at night and marveled at the wondrous display of the moon, the planets, and the multitude of stars set in constellations or in the Milky Way. During the day this same canopy impresses him in a different manner, for, due to the strong light from the sun, the zenith appears to be sky-blue and a sense of emptiness and vacancy is in evidence everywhere except for the clouds that may form in the lower levels of the



HOBAS WEST SIDERITE

This fell near Grootfontein, Southwest Africa. This find (1920) is reported to be the largest single mass of meteoric iron known ($3 \times 9 \times 9.67$ feet) 60 metric tons, 132,300 lbs. Iron 83.44%, nickel 16.24%. It shows no lines—an ataxite

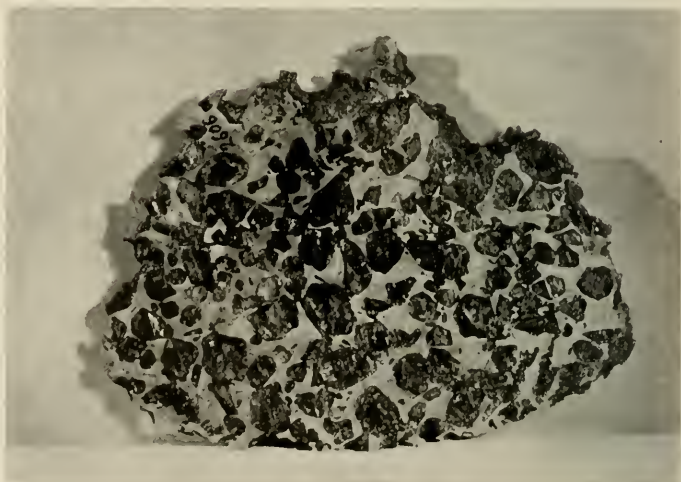
atmosphere called the troposphere. The stars and planets which are prominent on clear nights can seldom be seen in the daytime except from the depths of a well, a cave, a cañon or through a telescope.

Man has discovered from such observations spread over many centuries that these various celestial objects have regular yearly movements, that they are governed in their course by definite physical laws, and consequently he has grown accustomed to their regular movements, for he sets his clocks and watches by sidereal time, predicts the time of eclipses to within a few seconds of their happening, plants and harvests his crops according to the seasons, makes his home on the earth and plans his business undertakings for the coming year with full confidence that these bodies will continue their accustomed movements and functions.

On the other hand it has been more difficult for man to visualize the

through space towards the star Vega. The earth rotates on its axis at the rate of 17.28 miles a minute at the equator and travels at a speed of more than 1000 miles a minute along its path around the sun.

While these celestial and terrestrial phenomena are profound and have engaged the attention of scientific men and philosophers for more than two millenia, the occasional appearance of comets, and the not infrequent flight of meteors and meteorites have aroused special attention, for these phenomena are as yet not fully understood. Comets, meteors, and meteorites appear by day or by night. They are seen in flight more clearly by



OLLAQUE SIDEROLITE,
OLLAQUE, BOLIVIA

The polished surface shows olivine masses filling meshes of nickel-iron network



ARTIST'S SKETCH OF METEOR FALLING AT NIGHT. BY T. W. VOTER

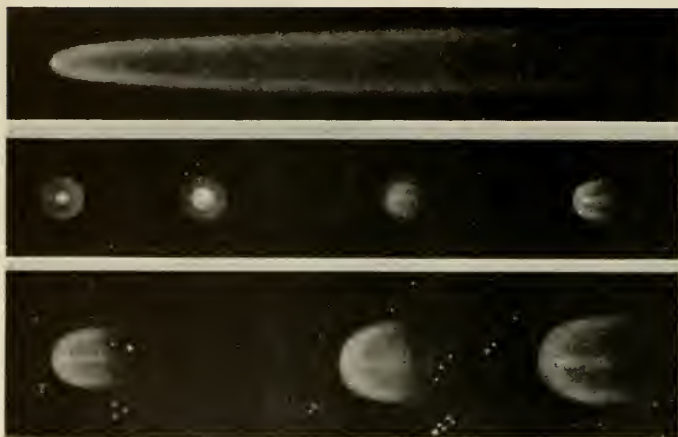
Meteors pass through the atmosphere at speeds varying from eight to fifty miles per second

night than during the day for at night their light is apparently stronger.

Comets are rarely conspicuous, for less than ten per cent of the several hundred thousand in the solar system can be seen with the naked eye. They vary considerably in size, some of the smallest have approximately the diameter of the earth; while the Great Comet of 1811 exceeded the size of the sun and had a diameter of fully 1,000,000 miles. The average size of many of them is 80,000 miles. Comets, which move in highly elliptical orbits of great extent are, according to Kepler's laws, much more rapid in their motion when near the sun than when far away. Moreover, since most of them are illuminated only during the short interval when they are near the sun, they travel most of the time in the cold realms of space as dark objects or faintly luminous bodies.

Comets usually have a brilliant head and tail when seen near the sun. The long tail, if present, generally streams

across the sky for millions of miles in directions away from the sun. The brilliant head is hazy and nebulous in appearance and may change in size when swinging through that portion of its elliptical orbit nearest the sun, called perihelion. Although the head may be great in size its mass is exceedingly small, being less than that of the major planets. Within the head a sharply defined star-like nucleus is usually visible. This nucleus is generally believed to be composed of a swarm of meteors and meteorites, whereas spectrum analyses show that the outer portion of the head consists of the extremely rarefied gases cyanogen and carbon monoxide. The tail is not in evidence when the comet is far from the sun, but, as the sun is approached, an atomic activity is set up within the head and electrons are driven off into space to form the tail. Some force, perhaps the sun's light pressure, radiation pressure or electrical repulsion within the comet's



HALLEY'S COMET

C. P. Smyth's drawings of Halley's comet, 1835-1836. From Chamber's *Story of the Comets*

head, is responsible for the lighted tail. As shown by an accompanying drawing, the tail points away from the sun even after the comet has passed around the sun and starts on its return trip. Then the tail precedes the body of the comet. At various times the tail has been observed to consist of various streamers emanating from the head.

It would seem that those particles of matter which are driven out of the head to form the tail are lost and must be constantly renewed, for it has been noted that comets whose orbits are small and pass frequently about the sun are relatively faint and often devoid of a tail. May it not be that their frequent passage about the sun has deprived them of the gaseous tail-forming material?

Comets or at least some of them follow regular orbits. Newton, in studying the comet of 1680, ascertained that, according to the laws of gravitation, the path of a comet should be an elongated curve, and represented the course of such a body mathematically. Halley, in 1704, collected the observations on 24 comets, calculated their orbits, and found that the comet of 1682 had a path round the sun similar to that of the comets of 1456, 1531, and 1607. He recognized them as recurrences of the same comet and, although their periods were not exactly

equal, due to interference by the planets Jupiter and Saturn, he predicted that this comet would return, subject to the influences of the planets, about 1758. Other astronomers took up the calculations of the algebraical and numerical

formulae and determined that Saturn would delay the return of Halley's comet 100 days and Jupiter 518 days, a total of 618 days. The comet was observed to pass perihelion on March 12, 1759. It returned again on November 15, 1835, after completing its course in 28,006 days. In 1873 it reached aphelion and returned once more in 1910. Halley's comet thus has an average period of about



Photograph by Max Wolf

COMET MOREHOUSE (1908 III)

Discovered November, 1908, by D. W. Morehouse at Yerkes Observatory, Wisconsin. A series of parabolic hoods enclose the head of the comet. From *Handbuch der Astrophysik*, Band IV

COMET RORDAME

July, 13, 1893. The camera moved with the comet, hence, the stationary stars show as short white lines



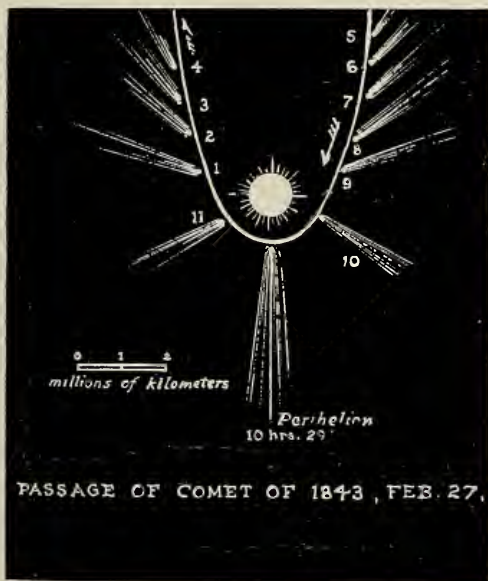
Photograph by E. E. Barnard, Lick Observatory, Calif.

76½ years. These calculations and observations removed comets from the domain of legend and established them as part of our solar system.

The periodicity of a considerable number of comets has been confirmed. Of these Encke's comet, discovered November 26, 1818, is the "Mercury of Comets." It completes its elliptical orbit of 2,324,060,000 miles in 3.3 years. It is brightly lit up when it passes within 31 million miles of the sun and may then be readily seen with a telescope. In its revolutions it is also affected by planetary disturbances as are some 60 other comets with known periods of less than 80 years. Astronomers divide

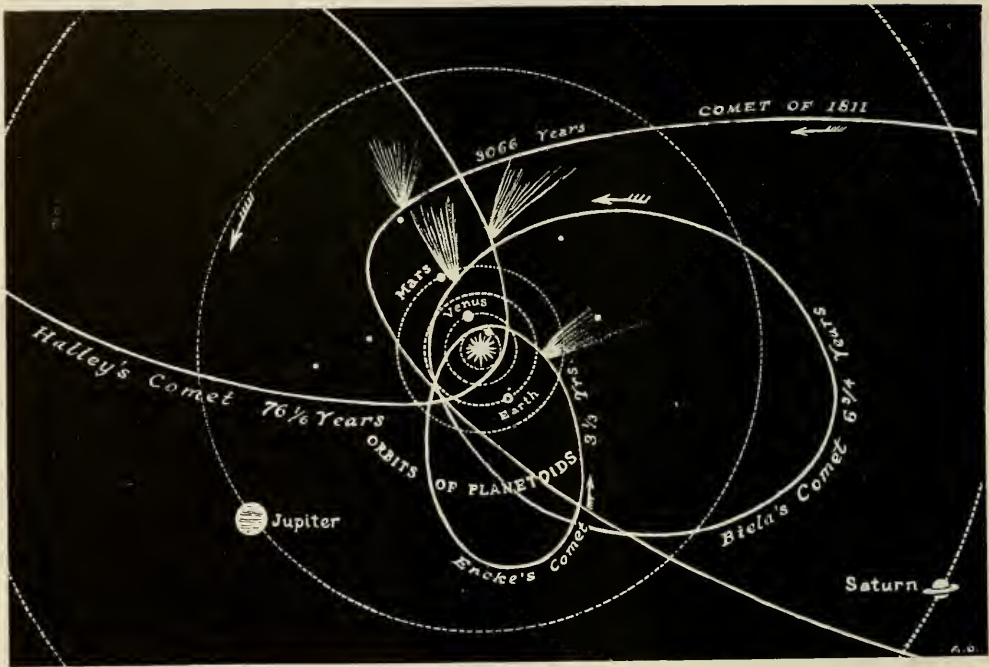
this assemblage of comets into four groups and name them after the four major planets, Jupiter, Saturn, Uranus, and Neptune. Jupiter's family, the largest, has some fifty members including Encke's comet, with periods 3.3 to 8.9 years; Saturn's family has four members with periods 13.1 to 17.7 years; Uranus has two with an average period of 36.6 years; Neptune's family has nine members including Halley's comet with a mean period of 70.0 years. The influence of Jupiter on the first group has been for the most part established, but the connection of other planets with their assigned members is not universally recognized.

There are a number of instances on record which show that not only the orbits, but also the comets themselves, may be considerably affected by passing near the planet Jupiter. For instance, the orbit of Lexell's comet of 1770 was so changed in 1779 that it could not be seen. In 1770 it passed within one and a half million miles of the earth. Changes have also been noted in d'Arrest's comet 1860, Brook's 1886, Wolf's 1875 and 1922. The 1922 perturbations of Wolf's comet modified the orbit to such an extent that it took a course nearly the reverse of that of 1875. Biela's comet whose period of 6.75 years was established in 1826 had been seen in 1772 and 1805. Its orbit



SECTION OF A COMET'S PATH

Passage of the comet 1843 about the sun. This comet covered the perihelion portion of its orbit, twelve million kilometers, in ten hours. The tail pointed away from the sun



ORBITS OF SOME COMETS AND PLANETS

While the earth encircles the sun in one year, Encke's comet takes three and one-third years, and other comets a longer period. Most comets have paths which do not lie in the plane of the earth's orbit

was found to intersect that of the earth's, and in 1832, when it returned, there were many needless apprehensions. It was not seen in 1839, but in 1846 it was found to have split into two comets, which travelled side by side. In 1852 it reappeared with the two comets farther apart. It was not seen in 1859 or in 1866, and for the years 1872, 1885, 1892 and 1898, there was no comet, but instead brilliant showers of meteors. Other known comets have also disappeared, namely: Brorsen and Temple I, in 1879. The Pons-Winnecke comet with a period of 5.6 years has also attracted considerable attention because of irregularities in its orbit and its period. Discovered in 1819, its perihelion distance, although changed every alternate revolution by Jupiter, remained within the earth's orbit up to 1915, when it went outside. In June, 1916, and June, 1927, there were meteoric showers, which were associated with this comet. Some astronomers would

also connect this comet with the great meteoric fall, which crashed into an uninhabited region of central Siberia in 1908, where, after the reported appearance of a great light followed by many detonations, an area of some 1,000 square miles, was completely devastated.

The most prominent member of Saturn's family is Tuttle's comet, discovered in 1858, with a period of $13\frac{1}{2}$ years. It has been seen at every return since 1858.

Temple's comet, discovered in 1866, is the more notable of the two comets of Uranus. Its period of 33 years and its orbit coincides with that of the Leonid meteors with brilliant displays in November, 1833, 1866, and less so in 1899, since perturbations of Jupiter had changed its course. Its motion is retrograde to that of the planets. Stephan's comet seen 1867, but not since, is the other member.

Of Neptune's nine comets five have been seen a second time. Halley's is the best known. It has been traced back to

IRON METEORITE FROM
GIBEON, SOUTHWEST
AFRICA

A black carbon nodule appears near the center of the polished and etched surface; Widmanstätten figures cover the remaining portion of the slice



240 B.C. On various occasions it has approached near enough to the earth to give meteor showers. It was observed in 467, 1066, 1456, 1531, 1607, 1759, 1835 and 1910. It crossed the sun in 1910, but since it was then invisible, it demonstrates the very small amount of matter remaining in it.

Other comets with periods ranging from 119 to 165 years have been observed, and one with a period of 335 years suggests a family belonging to an extra Neptune planet.

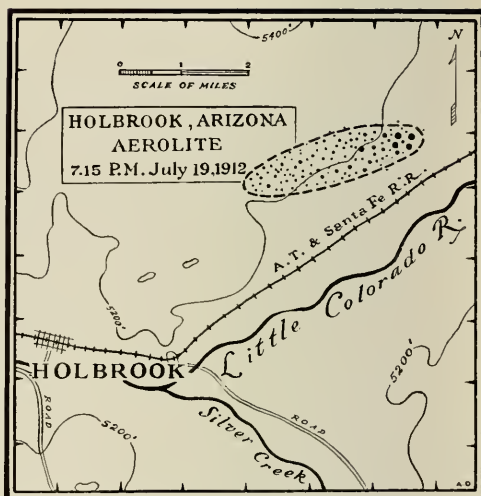
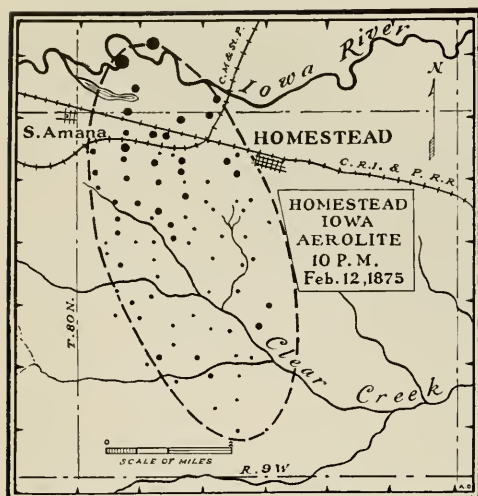
In this connection it should be stated that while comets may be seen at various times as they pass about the sun, meteors can be seen only when they enter the earth's atmosphere. In various instances it has been noted that where comets approach or cross the orbit of the earth, or disintegrate, meteoric displays have been observed.

Not infrequently on clear nights faint moving sparks of light may be seen to emanate sporadically from the starry canopy and increase in brightness as they move rapidly towards the earth, but seldom reach it before quickly and silently disappearing. Such objects are called "shooting stars" or small meteors. Occasionally, a brilliant streak of light with a more or less well-defined head called a "fireball" or "bolide," accompanied by a hissing sound and detonations, will light the sky momentarily and strike the earth at a place near or beyond the range of vision of the observer. These are also meteors, but of a larger size than the shooting star type. Perhaps a cloud of dust will be seen to rise from the place where it struck and its lodgment can be definitely located. When the spot is approached, there may be seen a newly made hole, one or more feet in



A PORTION OF THE
ROSE CITY, MICHIGAN,
METEORITE

Composed of a network of stone and metallic masses with a black crust appearing on the upper and lower margins



(Left) THE HOMESTEAD, IOWA, [SHOWER.—Showing a characteristic ellipsoidal area, 3×6 miles. Pieces weighing 32 kilograms were found along the northern margin. (Right) THE HOLBROOK, ARIZONA, SHOWER.—The ellipsoidal area is 1×3 miles in extent. Many thousands of small fragments have been recovered

depth with an object in the bottom of it. The object may be either a stone with a blackened surface or an irregular mass of metal marked on the front or “brust-seite” with shallow furrows and subconical pits, and on the rear side with depressions called thumb-marks or “piezoglyphs.” Sometimes the thumb-marks are found on all surfaces. These markings are due to superficial heating produced by friction with the air. Whether the object has a stony or metallic aspect its appearance will be unlike any terrestrial rock or stone and may be called a meteorite.

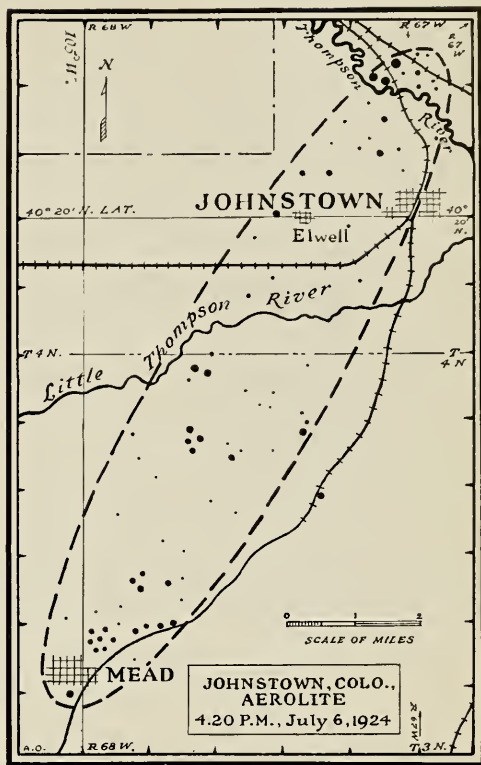
Stony meteorites often fall as showers due to the fact that the original mass explodes or bursts one or more times before reaching the earth. The areal distribution of the stony fragments on the surface of the ground usually assumes the form of an ellipse varying in size from one-half mile in width to three in length as in the 1912 Holbrook, Arizona, fall, or three by six miles as in the 1875 Homestead, Iowa, fall, or three by ten miles as in the 1924 Johnstown, Colorado, fall, as shown diagrammatically in this article. The individuals of a shower are distributed

according to their momentum, those of small size with less momentum will reach the ground first, while those of large size and greater momentum will be carried farther. This fact affords corroborative evidence in determining the direction of the path of the meteor. A comparison of the diagrams will show that the Homestead meteor traveled in a N.N.W. direction, the Holbrook in an E.N.E. direction and the Johnstown in a N.E. direction.

Nickel-iron meteorites are often found in single masses, yet in the case of the Cape York, Greenland, irons two large masses were found on one island, and one each on two near-by islands, suggesting a single fall. The large mass, Ahnighito, 36½ tons, the Woman, 3 tons, and the Dog, 960 pounds, are in the American Museum. The other piece, 3.4 metric tons, is in the Royal Museum at Copenhagen, Denmark. The Bethany irons in southwest Africa have been found singly in rather widely separated areas, yet when their distribution is plotted it suggests a shower. The most recent find in this region is that of Hoba West iron near Grootfontein, Southwest Africa. It is estimated to weigh 60

metric tons and is reported to be the largest single mass known.

Mr. Hirn, writing in *L'Astronomie*, June, 1883, calculated that a bolide entering the upper regions of the atmosphere with a relative velocity of 18.64 miles per second, compressed the air in front of its path from one-hundredth of an atmosphere on entering to 56 atmospheres at a height of 23 miles. He also determined that with increase of pressure there is an increase of heat and a rise of temperature on the exterior surface to points higher than can be produced in the laboratory. The temperature of space is 273° below zero Centigrade. It is assumed that the bolide had this temperature before entering the earth's atmosphere. If so, then its surficial temperature was raised from -273° C. to $3,340^{\circ}$ C. in the few seconds of its flight. If this calculation be true it is readily understood why a meteor becomes visible on account of this transformation of its motion into heat and light. Neither is it difficult to perceive why the small masses of "shooting stars" are consumed, why the larger stony masses with low conductivity are rent into fragments by explosions, and why the more tenacious



THE JOHNSTOWN, COLORADO, SHOWER

Four terrific explosions were heard accompanied by "smoke" puffs, before the fragments were spread over an ellipsoidal area some 3×10 miles in extent

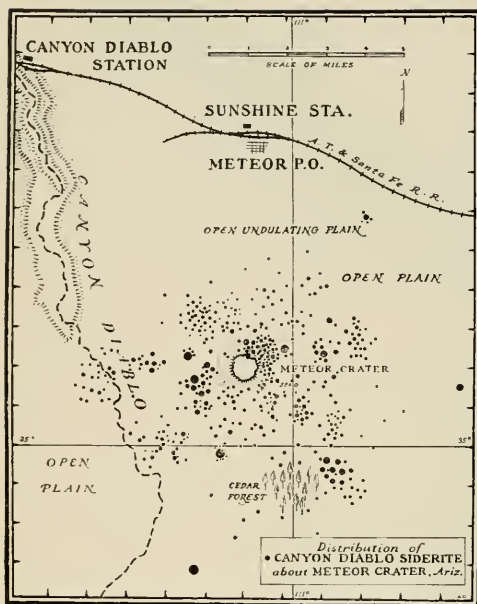
irons usually remain intact and have irregular outlines and pitted surfaces.

It is also known that the greater the air pressure the more the velocity of the meteor is checked. This fact would explain the shallow depth of the holes made in the ground by most meteorites. The height at which some meteorites lose their initial velocity is quite variable. On the basis of some nine, which have been studied, it varies between 2 and

THE JOHNSTOWN, COLORADO, AEROLITE

One of the thirteen pieces found showing a thin black crust and a gray stony interior. Rounded and angular particles of greenish-gray pyroxene are in evidence in the gray field





SKETCH MAP

Showing position of Meteor Crater and the Canyon Diablo Meteorites

29 miles above the surface of the earth. Some few meteors, however, have made great holes in the ground.

The most remarkable occurrence of iron meteorites associated with a meteor crater is in Yavapai County, Arizona, near the intersection of the 111th meridian and 35th parallel. The meteorite, which is called Canyon Diablo, after a near-by erosion feature, consists of thousands of pieces of variable sizes scattered over an oval area about nine miles in diameter. A depression known as Meteor Crater

lies in the center of the meteorite field. This crater is quite large being 4150 feet in diameter and 570 feet deep. It is surrounded by a parapet, 150 feet in height composed of rock debris thrown out of the crater. The crater has been studied at various times from different standpoints and the present general consensus of opinion is that it was formed by the impact of a great meteor or comet with the earth some 50,000 years ago, and that immediately following the impact there was a tremendous explosion which not only scattered the meteorites and rock debris over the surrounding plain, but gouged out the crater pit and greatly disturbed the normal disposition of the thick limestone and sandstone beds in the margins of the crater. Borings have been made within and about the margins of the crater in an endeavor to locate a possible larger meteoric mass, but so far they have yielded only inconclusive results.

Other meteor craters and associated



THE CANYON DIABLO METEORITE

A large mass of the Canyon Diablo siderite in the American Museum. Total weight of fall unknown; six tons preserved in collections

meteoric material have recently been found at Henbury, Australia and Odessa, Texas. No meteorite fragments, however, have been found near the meteor craters of Tunguska, Siberia, and Kaali, Esthonia.

So seldom are meteorites seen to fall that it is not strange that such phenomena should attract widespread attention whenever and wherever they occur. Neither is it strange that skepticism should arise in the minds of non-witnesses regarding the existence of objects which are reported to have fallen from the heavens.

Early records show that meteoric showers were regarded as supernatural. According to the late G. P. Merrill of the Smithsonian Institution, such phenomena are referred to in Revelations vi, 13; viii, 10; and xii, 3, 4. E. F. F. Chladin in 1819 stated that one of the oldest meteoric falls on record is that of Crete, 1478 B.C. Pliny in his second book, *Naturale Historie*, mentions that in 468 B.C. a Greek



Photograph by Clyde Fisher
METEOR CRATER, ARIZONA, FROM THE RIM
Looking across the crater pit, 570 feet deep and
4150 feet in diameter

philosopher, Anaxagoras Clazomenius, foretold that with the appearance of a comet a stone should fall from the sun. Such a stone did fall at Abydos and was held in great reverence. Records also show that at 11:30 P.M., on November 7, 1492, a meteorite fell at Ensisheim in Ober-Elsass, Germany. This stone was regarded as a miracle of God and by order of King Maximilian the main mass, weighing 260 pounds, was placed in the church at Ensisheim. This meteorite is of interest in that it constitutes



AIRPLANE VIEW OF
METEOR CRATER, ARIZONA
Taken by Clyde Fisher,
January 12, 1933, with snow
on the ground. Canyon
Diablo and the San Francisco
Mountains in the background

the oldest known fall of which samples of the specimen have been preserved.

As noted by Dr. O. C. Farrington, 1915, the first stony meteorite observed to fall in America, and which was described, was that of Weston, which fell 6:30 A.M., December 14, 1807, in Fairfield County, Connecticut. In commenting upon this fall Thomas Jefferson, President of the United States, expressed the prevailing opinion in regard to meteorites when he said that it was easier to believe that Yankee professors would lie than to believe that stones would fall from heaven.

The brilliant display in November, 1833, of shooting stars, later known as Leonid meteors, associated with Temple's comet, brought forth a decided change in

the general attitude of the public in regard to meteoric phenomena.

With this change in attitude it is interesting to note by centuries the record of meteorites which were seen to fall and portions of which have been preserved. Referring to G. P. Merrill's 1929 list of 482 falls, we note that for the 15th and 16th Centuries there is one each; for the 17th, three; for the 18th, nineteen; for the 19th, three hundred forty-two; and for the first third of the 20th, one hundred sixteen. This shows quite conclusively that during the centuries when meteorites were regarded as being supernatural, few specimens were found, and that during the 19th and 20th Centuries, when they received attention, many were recovered.

Out of a total of 482 seen to fall, 458



A GREAT BOLIDE OR METEOR, AS SEEN THROUGH A TELESCOPE

Photograph by Josef Klepesta at the Prague Observatory, September 12, 1923. The white spots are stars. The bolide is the white streak of varying width. It crossed the field of the camera as the great spiral nebula in Andromeda (center) was being photographed

SHOOTING STAR AS
SEEN THROUGH A
TELESCOPE

Nebulae in Cygnus to the right. The stars show as white dots. Photograph by E. E. Barnard, Yerkes Observatory, Wisconsin, July 15, 1909

represent stony meteorites, 5 stony-irons, and 22 nickel-iron meteorites. Stony meteorites are thus seen to fall more frequently than the iron meteorites, of which 350 had been found to 1929, but only 22 seen to fall. The number of falls and finds known in 1929 was 832. The list has been considerably increased during the following four years. The American Museum Collection of meteorites (March, 1933) contained 2640 specimens, representing 569 falls and finds.

Large collections of meteorites reveal

that the specimens of no two falls are exactly alike in structure or composition, yet it has been observed that they may be arranged into three principal groups or kinds, as noted by Merrill namely:

1. Aërolites, or stony meteorites, consisting essentially of silicate minerals with minor amounts of the metallic alloys and sulphides.
2. Siderolites or stony-iron meteorites, consisting of an extremely variable network or sponge of metal, the interstices of which are occupied by one or more silicate minerals.
3. Siderites or iron meteorites, consisting essentially of an alloy of nickel-iron with iron phosphides and sulphides.



Technical students of meteorites have subdivided each of these groups. The aërolites and siderites are, however, the more common kinds. When cut, polished and etched, the siderites, or iron meteorites, usually show peculiar markings of crossed lines, and thus can be easily distinguished from the terrestrial irons.

Some siderites have the nickel-iron alloys arranged in the form of plates parallel with the faces of an octahedron. These lamellae may be of different degrees of thickness and composed of one, two or three kinds of metal. On etching with acid these metallic bands react unequally

and show characteristic figures known as Widmanstätten lines.

Another group of iron meteorites, composed of homogeneous masses of nickel-iron, show cleavage and lamellae parallel to the faces of a hexahedron. This is due to the twinning of a cube on an octahedral face. On etching with dilute nitric acid the structures show Neumann lines. Such forms are known as hexahedral irons.

A third group of irons are called massive irons or ataxites because their structure is amorphous and shows neither Neumann or Widmanstätten lines or other pronounced features.

The structure of the aërolites is quite different. They resemble the light colored felsitic rocks of the earth's crust, but they are unlike them. Aërolites may be granular, crystalline, chondritic, basaltic, tuff-like or breccia-like and with or without veins. Metallic shreds may or may not be scattered through the mass. While the color is usually light gray, it may vary through various shades of gray to black. A characteristic feature of aërolites is that while their interiors may be gray in tone,

with various chondrules or mineral grains in evidence, their exterior surfaces are always coated with a thin black crust, which varies in thickness from $\frac{1}{64}$ to $\frac{1}{32}$ of an inch.

Astronomers tell us that about 400,000,000 celestial objects enter the earth's atmosphere every day, that about 20,000,000 are large enough to form shooting stars or meteors, and that of this number a minimum of but one per day is of sufficient size to reach the earth and constitute a meteorite. At first it may seem strange that so many meteors enter the atmosphere and so few reach the earth. When it is recalled, however, that meteorites vary from sizes microscopic to objects measured in tens of cubic feet, that they enter the upper rarefied layers of the earth's atmosphere at speeds varying from 8 to 50 miles per second, and that the atmosphere offers great resistance to their passage, it is not surprising that in the few seconds of their flight through the atmosphere that most of them are heated

to the point of incandescence and consumed before they reach the earth.



ARTIST'S CONCEPTION OF NOVEMBER METEORS
NOVEMBER 13-14, 1866



Photograph by Ewing Galloway

Native Mint in the Solomon Archipelago. Working the Shells with Bowdrills

PRIMITIVE DOLLARS

Various Forms of Currency That Have Been and Are Being Used by
Native Peoples in Various Parts of the World

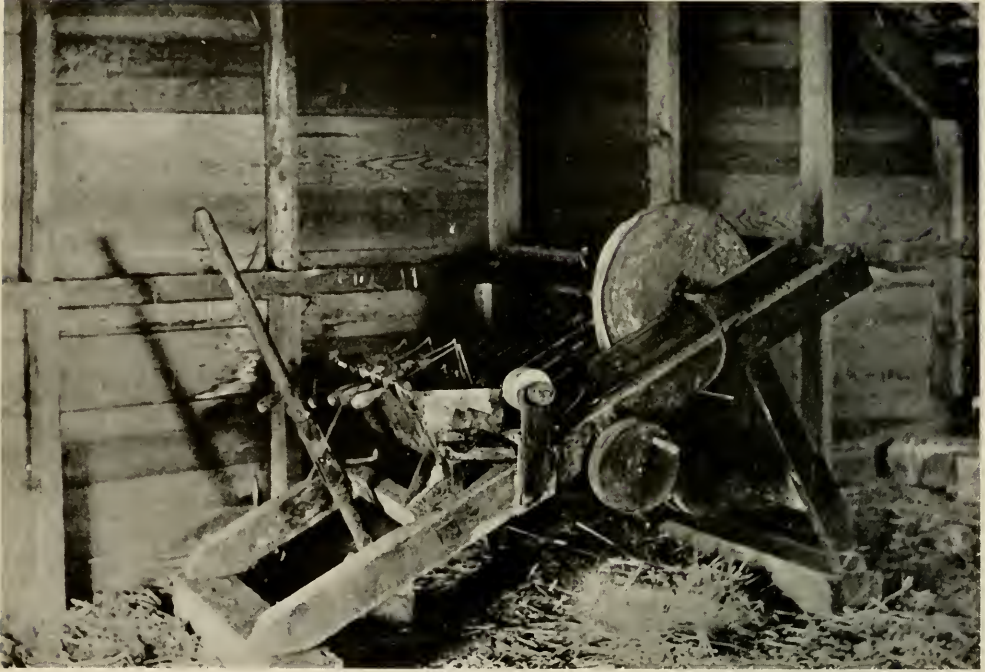
By BELLA WEITZNER

Department of Anthropology, American Museum

DURING the past few months many communities in the United States have endeavored to find substitutes for money. Whenever the more complicated monetary systems collapse, mankind has a tendency to return to more primitive forms of money or to the age-old barter. It may be of interest, therefore, to review briefly some early attempts to find suitable materials for money and to stabilize values.

We turn our attention first to some of the currency usages in aboriginal North America. The one important medium of exchange known to child and adult alike, was the wampum of the Atlantic Coast tribes, the name being a corruption of an Algonkin word. Opinions differ as to the form of these shell beads in prehistoric times. The wampum known in the early

Colonial period, made from the quahog and other shells, was tubular or cylindrical, the beads being from one eighth to three-sixteenths of an inch in diameter and one-eighth to seven-sixteenths in length. On the basis of archæological finds, it appears that the disc-shaped wampum pre-dated the cylindrical type, since great quantities of the former have been found in definitely prehistoric sites. It is clear that contact with the colonists served to stimulate and increase both its use and production, and we read of a rude machine invented by a colonist to produce wampum, simplifying the long and laborious process of cutting, smoothing, and drilling the shell. Two factories were known to have been in operation, one at Hackensack, New Jersey, the other, at Babylon, Long Island.



A WAMPUM MACHINE

Though crude, such a contrivance was capable of producing wampum in much larger quantities than was possible by the tedious native method of cutting, drilling, and polishing with more primitive implements. Producing wampum by this method rapidly depreciated its value

Wampum had important ceremonial associations for the northeastern Algonkin Indian tribes and the Iroquois. It was used also in payment of tribute, of gifts, as compensation for crimes, as indemnity for murder, and as the insignia of rank. Whatever may have been its significance in prehistoric times, from the very beginning of the Colonial period wampum played an important rôle in the economy of both the native and the white population. It was not only the medium of exchange between the two groups, but served for intra-colonial trade as well. So prevalent was its use that as early as 1640 it was ruled to be legal tender in New England. At this period it fluctuated in value from four to six beads to a penny. From 1641 to 1662 its use gradually decreased in New Netherlands, though it continued in circulation until 1693. Its recognition as official currency

in the colonies prompted the manufacture of inferior substitutes, poorly made, of stone, bone, glass, horn, and wood. Unsuccessful attempts were made to stabilize its value; consequently, it lost its status as legal tender in Massachusetts and the other New England colonies beginning in 1661. During practically the entire period of its supremacy as colonial currency, huge quantities of wretchedly finished, unpolished, and actually counterfeit wampum, were placed in circulation, resulting in the passage of many ordinances designed to stabilize its value. We quote one by the Council of New Netherlands dated May 30, 1650:

Whereas, we have by experience, and for a long time seen the decline and daily depreciation of the loose wampum among which are circulating many with holes and half finished; also some of stone, bone, glass, muscle-shells, horn, yea, even of wood and broken beads, together with the manifold complaints of the inhabitants that they cannot

go to market with such wampum, nor obtain any commodities, not even a small loaf of white bread or pot of beer from the traders, bakers, or tapsters for loose wampum . . . in order hereby to prevent the further importation of all lump and unperforated wampum, so as in future to obviate all misunderstanding, the Hon'ble Director and Council aforesaid, do ordain that the commercial shall pass and be good pay as heretofore, to wit, six white or three black for one stiver; on the contrary, poor strung wampum shall pass eight white and four black for one stiver (one penny).

The average value of wampum at this period was 120 beads to the Dutch guilder.

Even prior to European contacts wampum had rather definite values aside from its ceremonial significance. White, to the Iroquois, was the color of peace and prosperity, black or purple, the color of ill omen; yet, despite this adverse symbolism, the dark wampum was everywhere commercially more valuable. For example, Roger Williams cites six white and three black beads as equivalent to one penny. By extension 360 white and 180 black beads, which constituted one fathom, the prevailing unit of measure for wampum, was worth five shillings. A wampum belt five inches wide was valued at ten pounds sterling. The Delaware in New Jersey held one fathom of wampum at five Dutch guilders. In Virginia a yard of purple wampum was rated at eighteen pence; a white string of the same length was worth nine pence.

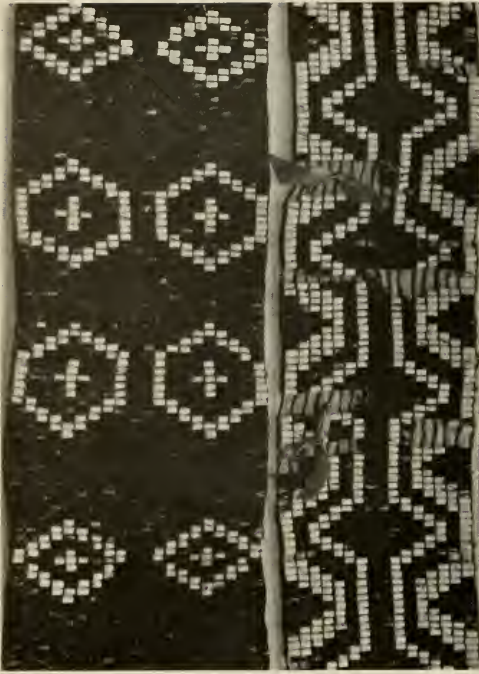
Early in the history of Virginia the wampum was replaced by glass beads which were so much in demand as currency that in 1621 a glass furnace was built and Italian workmen were brought to the colony to manufacture the beads.

On the Pacific Coast of North America, from northern California to southeastern Alaska, dentalium shell currency held a position somewhat comparable to that of wampum in the east. The shells were frequently decorated with incised designs. They varied in value in accordance with



A KWAKIUTL INDIAN CHIEF WITH A BROKEN COPPER

The breaking off of the sections of a copper followed a prescribed sequence. The upper corner was always the first broken, then the lower corner diagonally opposite from it, the upper left hand corner, and finally the lower right hand corner. This left the T-shaped center which was valued at two-thirds the total worth which, however, was not fixed, depending largely upon the amount of property given away during the ceremony at which it was sold. The design on the copper usually represented the crest animal of the owner



SECTIONS OF TWO ALGONKIN
WAMPUM BELTS

The design motive, its repetition, and the combination of colors were significant on wampum belts whether they were used in ceremonial or monetary transactions

their length; in western Washington, for example, the count ran forty shells to a fathom, which was, in turn, equivalent to five dollars in our currency, and further, the purchase price for one slave. A single large shell was rated at one dollar. The marriage price for a woman among the Shasta Indians in California was reported as fifteen or twenty large dentalium shells, ten to fifteen strings of disc-shaped beads, and twenty or thirty woodpecker scalps which also played their part as exchange media in the California area.

During the period of exploration and colonization in the vast interior of North America, trade with the Indian tribes was fostered on a foundation of animal skins and the skin of the much-desired beaver became the recognized standard of value. Eventually the terms, skin and beaver,

became practically synonymous. Values were regulated and transactions completed in these terms, even fractions and multiples of skins or beavers being considered in the reckoning. The skin or beaver was accepted as legal tender in some parts of the country, not only during the Colonial Period, but for many years following. Beaver and wampum served coincidentally as currency and we find some interesting fluctuations in values recorded in the period between 1648 and 1672. The Dutch are said to have paid two fathoms of white and one fathom of black wampum for one beaver. Later, the price for a beaver was two strings of wampum; a good bearskin was also worth one beaver which was, in turn, valued at two strings of wampum. In 1655 beavers were valued at nine Dutch guilders each.

As early as 1613 the beaver had become established as the basis of trade between the French in Canada and the Indians. Some values current in 1670 are cited by Margry. One beaver was worth a fathom of tobacco, a quarter pound of powder, six knives, or a few blue beads. Among



BRONZE AGE MONEY

The eight rings are the actual currency; the bracelet is merely the means of carrying the circlets. Found in a Lake Dweller village in Wollishofen, Switzerland. Illustration copied from G. G. MacCurdy's *Human Origins*

the Indians of the Southern Plains one beaver was valued at two good otter skins, or from ten to twelve raccoons, or four or five wild-cats. With the close of the periods of exploration and colonization the beaver as currency lost its prestige everywhere but in Canada, where it continued as the standard for a long time.

On the Yukon, where the Russians were the dominant traders until the Alaska purchase, the land-otter skin was the standard unit of exchange. This was in turn equivalent to one large hair sealskin. Elk and moose skins replaced the dentalium shells on the northern borders of the North Pacific Coast culture area. Later, blankets of varying grades, with distinctive markings to distinguish values, were issued by the Hudson's Bay Company and these were substituted for many of the aboriginal media, or rather, the latter were now valued in terms of blankets. Among the Tlingit of this area slaves also had definite value in deerskins, from twelve to twenty such skins being an acceptable price for one slave. A good canoe had about the same rating, ten to fifteen deerskins.

In this general area also "coppers" held a high position as standards of value. These were shield-like sheets of copper embellished with symbolic representations of the tribal mythical heroes. On ceremonial occasions, when ostentatious display and distribution of property were



Photograph from Ewing Galloway

CARRYING PRODUCE TO MARKET

On Santos Island in the New Hebrides. In the Northern New Hebrides long, narrow, well-worn mats are used as money

the important features, the "coppers" were exhibited as the necessary tangible evidence of their owner's social prestige. They were frequently destroyed during public contests between rival chiefs who endeavored to establish their rank and demonstrate their superiority by showing their disdain of their most precious possessions. The "coppers" are valued in the trade blankets previously mentioned, some being rated as high as seven thousand blankets.

Horses, introduced into America by the Spaniards, spread rapidly northward, particularly in the great open plains. Once in the possession of the Indians of that area, they exercised an enormous



Photograph by Margaret Mead

A MELANESIAN MONETARY TRANSACTION

Strings of dogs' teeth and shell currency displayed at a dance during a ceremonial exchange of property in the Admiralty Islands

influence on the mode of life of these people, increasing their mobility, and thus extending their raiding, hunting, and war range, so that the ownership of horses became the universal goal. Consequently, horses readily became the media of exchange. They had neither stability nor uniformity of value either within a single tribe or for intertribal trade, but entered nevertheless into all transactions of importance. They were regulation fees for ceremonial instruction; were accepted as payment for medicine bundles or for such products as maize among the tribes where it was grown; they were used in varying numbers as reciprocal gift payments in marriage; in short, in any exchange, either secular or ritualistic.

Finally, we may mention an area of high culture in aboriginal North America where a form of currency was known. In ancient Mexico, as elsewhere, exchange or barter was the real foundation of trade,

but a few products like textiles and maize are classifiable as true mediums of exchange. It has been assumed that T-shaped ax blades of very thin copper have been used as currency in Oaxaca. Similar copper ax blades, originally obtained in trade from Mexico, were highly valued among the Maya in the early days of the Spanish Conquest, when in good condition, at five *reales*, in poor condition, at ten blades for a *real*. As in Mexico, cloth was currency among the Maya, and here feathers functioned also. The commercial count of the Maya, like that for their calendar, was vigesimal. The Yucatecans traded salt, textiles, and slaves to the Uloa Valley peoples and those of Tabasco for bags of cacao containing a definite number of beans.

Our attitude toward the concepts of barter, trade, labor, payment received for services or for commodities, is naturally the product of our own economic *milieu*.

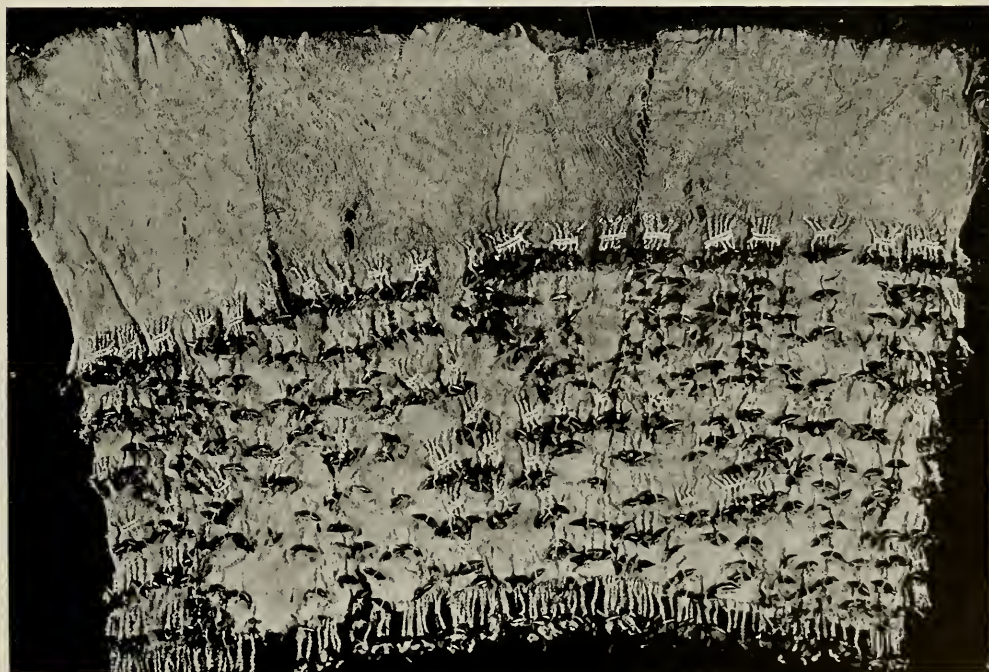
A BRIDE'S APRON

Part of the dowry of an Admiralty Island bride. The apron, woven of shell money, is worn not only as a part of the wedding costume, but on other occasions of ceremony, at the birth of children and at the feast given by the husband after many years of marriage

ANOTHER TYPE OF

BRIDE'S APRON

A bride's apron with pendent strings of shell money from the Admiralty Islands



It is only when our own system fails to function normally that our attention is drawn to these problems among people of dissimilar culture like the great numbers of primitive cultures known either from their archæological remains or still flourishing in varying degrees in many places over the world.

Broadly considered and by a slight extension of terminology we might assume that any product, any utilitarian or ornamental object used in trade or barter between two individuals or two groups, might be termed currency or money. Barter, or exchange of commodity for commodity, has great antiquity as evidenced by archæological remains practically in every place where the accumulated débris of older cultures has been studied. In Neolithic times, for example, amber was traded from its sources on the Baltic, first to the closely adjacent territory and later, during the Bronze Age, to more distant points in ancient Europe. In this latter period also commerce developed enormously and definite and much-traveled trade routes between the Baltic and the Mediterranean were established. Bronze objects of Italian origin found in remains of Neolithic Germany and Scandinavia are the objective evidence of this commercial contact. It is assumed that the Baltic amber was given in exchange for the bronze objects. This flourishing commerce resulted in the adoption and manufacture of a definite medium of exchange which consisted, in the main, of cast metal rings. One example of this type of currency found in a Lake Dweller village in Wollishofen, Switzerland, was a spirally twisted bronze bracelet on which eight small bronze rings were strung. Usually the commodities so exchanged among primitive peoples were those not obtainable or readily accessible in their own immediate environment.

Generally speaking, the concept of a definite well-defined medium of exchange

with values sometimes fixed, sometimes fluctuating, was world-wide in primitive cultures. For our present purpose we have defined currency or money as consisting of any objects recognized as having a value, not necessarily unchangeable, but established by usage as the medium of exchange for the group. These naturally varied with the environment, were tribally differentiated, and ranged as widely in value as in kind. A cursory survey such as is offered here, barely skimming the surface of the subject, can do no more than call attention to a few of the oddities and fantastic objects so used as mediums of exchange.

The use of shells as money, in natural form, cut to special shape, decorated and undecorated, is probably most widely distributed over the world. Among the Island groups in the Pacific, for example, the basic currency appears to be in the form of shells. However, we find additional media practically everywhere in this area. In Melanesia especially, where individual and group trade were highly developed, social distinction and prestige frequently had their foundation in these successful transactions. Yet, the objective representation of the accepted currency for a given group often consisted of objects of personal adornment or costume, presumably to make it possible, by wearing the currency, so to speak, the better to care for and display one's wealth.

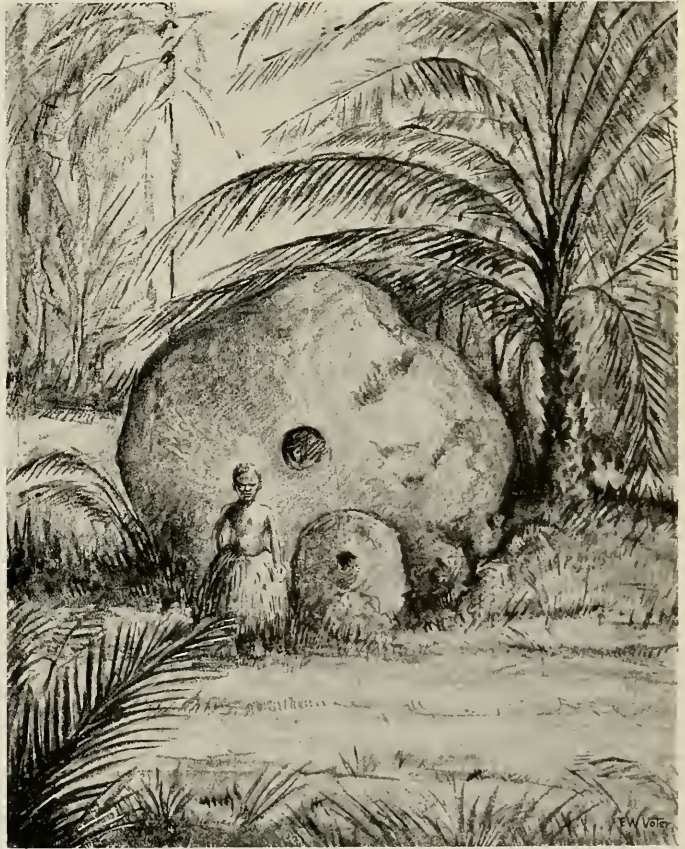
So in Fiji where it was important to accumulate whale teeth, it was equally significant to possess vast quantities of tapa which on ceremonial occasions were wrapped around the owner in practical demonstration of his wealth and social status. In the Loyalty Islands the red hair from below the ear of the flying fox constituted the accepted currency. In New Britain we encounter the widely distributed use of shells strung on fiber. Arrows loom large on the economic horizon in the Torres Straits, while in Samoa

specially woven mats are extremely important. In the Louisiade Archipelago iron adzes are used to construct canoes; the builders, however, accept payment only in native-made stone adzes, ten to fifty of these implements being the price range for building a single canoe. Pigs and wives as well are valued in this medium.

In the Caroline Islands three styles of currency are known. Pearl shells, obtained in the near-by Pellew Islands, are graded in value according to manner of trimming, size, and number. Ripe coconuts also have rough standards of value when exchanged for European trade articles; for example, three coconuts are worth one pilot biscuit, six coconuts, one stick of tobacco and a box of matches. Incidentally, the stick of tobacco is an important exchange medium in all Melanesian-white transactions. However, the most unique objects so used are the large stone wheels or *fei* found on the Island of Yap. These stone wheels are not manufactured in the Carolines, but in the Pillews whence they are transported by canoe or raft. They are fashioned of limestone or arragonite, and have been variously reported as ranging in size from six inches to twelve feet in diameter. Each stone ring has a central perforation for the insertion of a pole, like the axle of a wheel, on the rare occasions when this stone money is transported. For, strangely enough, though the *fei* are

highly desirable possessions for the Yap Islanders and are often displayed, after having been received as fee for a fishing expedition or for building a house, in front of the men's house, as proof of the high economic status of its inhabitants, they are rarely moved from place to place. Consequently, because of their immobility, the *fei* are not necessarily in possession of the actual owner or owners and frequently after a transaction are left in the care of the original owner, an acknowledgment of proprietorship being sufficient in the native code. Thefts of these stone wheels are unknown.

Quality of material and size are the dominating factors in their value; dis-



AN UNWIELDY FORM OF CURRENCY

The unique stone money of the Caroline Islands has frequently been compared to huge millstones. The sketch is based on descriptions and photographs in *The Island of Stone Money* by W. H. Furness 3rd



Photograph from Ewing Galloway

ZULU CATTLE

Among the Zulu as well as among other African peoples cattle are traded. In Uganda, for example, a cow set the value of other currency. Such stabilized values, as one cow being worth one male slave and four or five cows one female slave, have been reported

coloration or abrasion of the surface appear to have had no influence on worth. A *fei*, four feet in diameter, in good condition, was considered adequate compensation for the theft of a new wife. The smaller stone wheels are currency for the purchase of fish from the men's house or pigs from chiefs. A *fei* eighteen or twenty inches in diameter, of acceptable color and form, was adequate payment for fifty baskets (18 inches long and 10 inches deep) of food, a hundred-pound pig, or a thousand coconuts. Furness relates how a keen European trader took advantage of the high rating given the *fei* in the economy of the Yap Islanders by having similar stone wheels manufactured and offering them in payment for quantities of copra and *bêche-de-mer*.

Like many of the neighboring Island peoples the Mafulu of New Guinea recognized fixed values for dogs' teeth; for

example, a string of dogs' teeth equivalent in length to a pig, measured from the tip of its nose to the base of its tail, constituted the correct payment for it.

When we examine some of the currency usages in Africa we find again a large range and variety of objects. As is well-known, iron working is a well-developed and widespread industry among the native African tribes. It is not surprising therefore that in many sections of the continent iron in bulk or hammered iron ore ingots bearing distinctive tribal marks are recognized as currency. Iron spade-shaped discs are the exchange medium of the Bongo. In Equatorial Africa, iron axes, rings, or horseshoe-shaped pieces serve this purpose. In the areas where cattle raising is a dominating culture trait, cattle constitute money, as they did in Greece and Rome. Payment for the Malagasy bride in Madagascar is made in cattle.

In West Africa the shells of the cowrie which are not indigenous to the western coast and have been introduced from the east coast of the continent are the most important exchange medium, though as early as the Sixteenth Century, beads also served. In the Sudan strips of cotton cloth are the open sesame to native commerce, while to the wayfarer in Abyssinia salt is necessary for trade. Along the Slave Coast it was possible at one time to purchase a serving man with a small section of ivory tusk.

It is not always a simple matter to draw clear lines of demarcation in these primitive cultures between objects, even of fluctuating value but more or less established usage as mediums of exchange, and others which are so continuously and regularly bartered that they, too, may be placed in the same category. We find

such a situation among the Inca of Peru with their complicated political system and well regulated social and economic organization. Some authorities claim that such products as cotton, maize, copper, salt, coca leaves, or dried fish may be regarded as the currency of the ancient Inca while others contend that these, together with a long series of additional commodities, were merely exchanged for products foreign to the Inca. There appears then to have been no definite correlation between the concept of some distinctive definite objects as exchange media and high civilization in the pre-Spanish period in Peru. With the predilection of our own civilization toward the possession of gold, it seems strange that in prehistoric Peru, with its abundance of gold and silver and the demonstrated ability to fashion these metals



Photograph from Ewing Galloway

A BARTERING SCENE IN UGANDA, BRITISH EAST AFRICA

The native currency, ivory discs made from elephant tusks, has been successively replaced by glass beads and cowrie shells from the coast

in to objects of art not often surpassed in the products of aboriginal America that they were not used in this capacity.

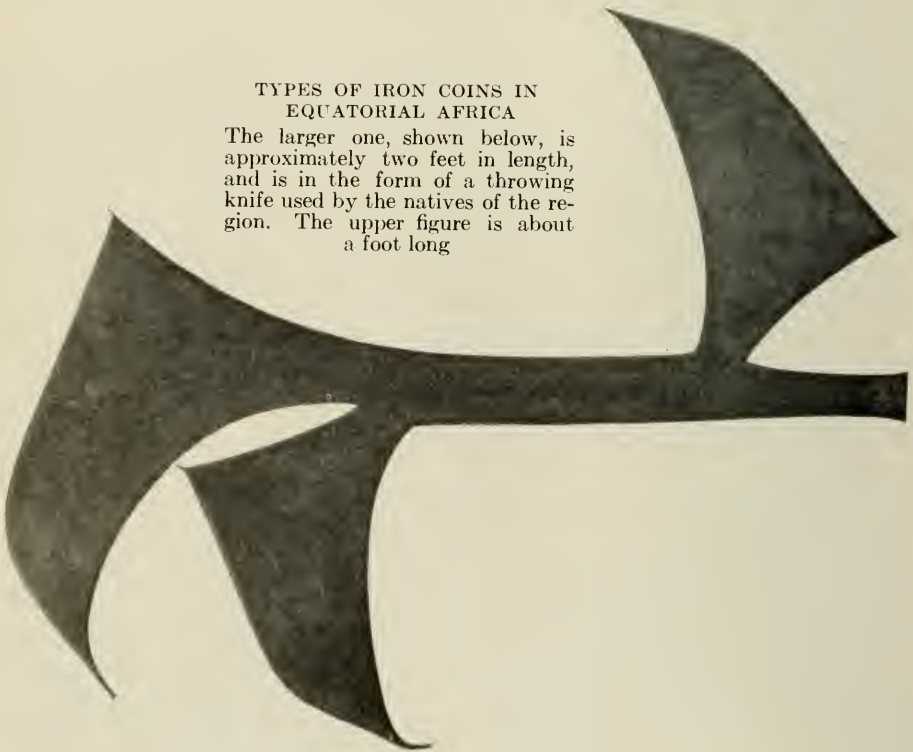
Further north in South America, salt was given in exchange for gold by the Quimbaya of Colombia. Again, textiles and emeralds, as well as salt, were used by the southern Chibcha to obtain gold from the peoples living on the Magdalena River. These latter examples are illustrative of the types of border line cases suggested above and are perhaps as readily classifiable as samples of primitive barter as of currency usage. The

only definite example of currency in aboriginal South America appears among the Chibcha who, for the payment of tribute and for the purchase of commodities from neighboring tribes, utilized gold discs, their value determined by measuring their size against the first joint of the thumb.

It is hoped that this rather inadequate survey has served to give some slight impression of the antiquity of this concept of currency, its universal distribution throughout the ages and among all peoples, and its variability in content as well as in attributed values.

TYPES OF IRON COINS IN EQUATORIAL AFRICA

The larger one, shown below, is approximately two feet in length, and is in the form of a throwing knife used by the natives of the region. The upper figure is about a foot long



"PRESERVATION" OR "RESTORATION"

Saving the Redwoods as an Example

By MADISON GRANT

BOOKS and papers are constantly appearing which dwell on the increasing disappearance of wild life. Man, the Destroyer, has, in a century, pretty well wiped out, within the present United States, the forests and the wild life of the forests, the birds of the air and the fish of the streams. Pennsylvania has only recently preserved, in Cook County, a grove of virgin forest, which is supposed to represent the last group of trees north of the Mason and Dixon Line that have never been touched by the axe or by fire. That is all that is left of the forests which once blanketed the country from salt water to the Mississippi.

At the same time that these forests were being cut down, much of our wild life was destroyed. The grizzly bear, the bison, the antelope, the mountain sheep, the caribou, and the mountain goat, as well as nearly all of the wapiti and deer, have been practically eliminated from the plains and mountains of the West.

Some animals, like the American bison, have been saved, and the increase of the captive herds, from a few hundred individuals in 1888 to the present number of more than 18,000, is a striking example of "restoration," but is not an example of "preservation."

The same can be said of some of our public parks and parkways. In fact, the genius of the American people seems to be first to destroy the beauty of nature and then, at vast expense, to endeavor partly to restore it. However, the purpose of this article is to tell of the first case where preservation on a large scale was carried to a most successful issue,—namely, the case of the California Redwoods.

These Redwoods, *Sequoia sempervirens*, originally extended from a point near Santa Cruz in California to the Oregon boundary, which they crossed for a distance of a few miles. They are confined to the coast range and flourish close to sea level. They derive their moisture not from

the summer rains, but from the daily sea fogs which drive inland. Where the fogs end, the Redwoods end. They are rather distant cousins to the Big Trees of the Sierras, *Sequoia gigantea*, which grow at an altitude of about 7000 feet. These Sierra Big Trees are found in isolated groups and, for the most part, are little more than magnificent ruins and relics, while the Redwoods form continuous stands and exist in their greatest beauty in Humboldt and Del Norte County, California. Those who have seen only the Santa Cruz grove and other forests near San Francisco, cannot form an adequate conception of the great beauty of the trees found to the north.

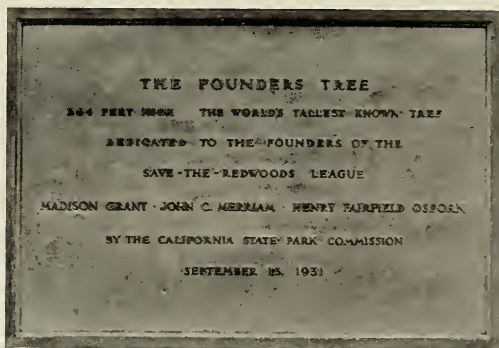
In August, 1917, the writer with two colleagues, Henry Fairfield Osborn and John C. Merriam, initiated a plan for preserving these noble trees, especially the superb groves of Bull Creek Flat on the south fork of the Eel River. The writer returned to the task several times during the next year or two in close association with the late Stephen T. Mather, and in August, 1919, organized the Save-the-Redwoods League. Several groves near Eureka in Humboldt County, the destruction of which had already begun,

were acquired as a start.

After languishing awhile, the League in 1920, took a sudden new lease of life by electing Dr. John C. Merriam, one of the original founders, as president, and Newton B. Drury, as secretary. As with every organization which is finally successful, its development was brought about by the skill and

active leadership of the president and the unselfish and continuous devotion of the secretary, ably seconded by Joseph D. Grant, of San Francisco, chairman of the Executive Committee. Many other men of note joined the Board of Trustees at that same time.

Long and tedious negotiations for purchase followed with the Pacific Lumber Company, which in every possible way obstructed the saving of the forests it owned on Bull Creek. Yet the



BRONZE TABLET MARKING THE WORLD'S TALLEST KNOWN TREE

ownership of redwood forests has never been especially profitable; few of the lumber companies have paid dividends. It is sad to think of the destruction of these magnificent trees without real benefit to anyone.

The purchase was finally consummated in August, 1931, and the finest forest in the world, including the tallest tree of the world, was preserved for all time. The League has had the active and very intelligent assistance of the State Board of Parks of California, and has received munificent support from individuals. Mr. John D. Rockefeller, Jr., alone, has given more than two million dollars and Mr. Edward S. Harkness more than five hundred thousand. Without the splendid support of these two far-sighted men little could have been done.

There were four major projects outlined by the League. Three of them have been entirely completed; namely, the acquisition of

I Bull Creek-Dyerville

II Prairie Creek-Humboldt Lagoons

III Del Norte Coast Park

Thirty thousand acres of Redwoods, the finest in the world, have been definitely saved at a cost of six million dollars. Incidentally, in one of the three great groves that the League has acquired, the Prairie Creek Grove, are the last remnants in California of the Roosevelt elk (*Cervus roosevelti*), which ranged from northern California up into Vancouver Island in British Columbia. At the present time the herd is supposed to number about three hundred, and it will be safe within the sanctuary of the Redwoods.

In short, the League has substantially accomplished its purpose and is the one outstanding example of the actual preservation on a large scale of an important portion of our national inheritance. It is an inspiration for further work, not of restoration, but of preservation, throughout the land. It is our duty as Americans to hand down to our posterity some portion of the heritage of wild life and of wild nature that was ours. In other words, to leave to them a country worth living in, with trees on the hillsides; with beasts in the forests; with fish in the streams; and, above all, with birds in the air.

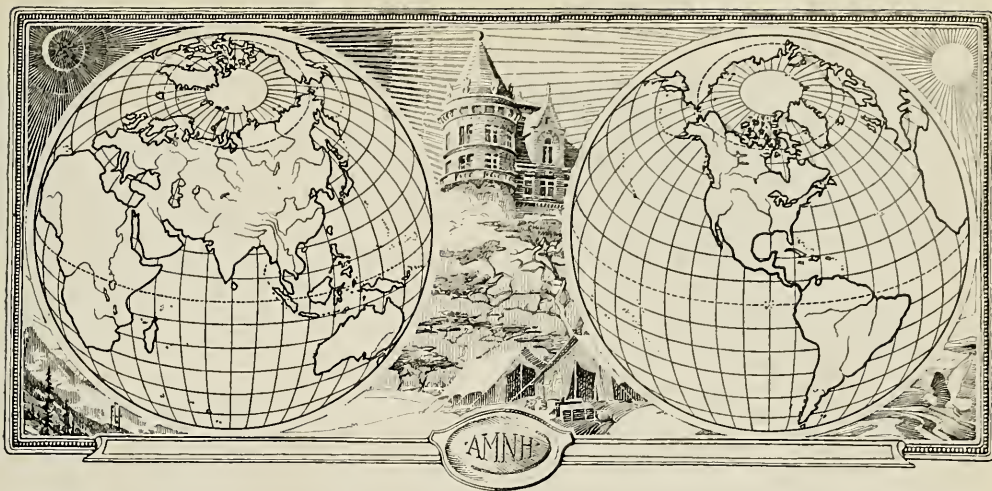
The conservationists of the United States can take heart at this example of something, not *to be* accomplished, or which *ought* to be accomplished, or which *may* be accomplished,—but of something which *has* been accomplished.

Even without the further additions to the Redwood Reservation which are contemplated, the record will stand for all time as that of a great achievement, and of a good work well done.



THE WORLD'S TALLEST KNOWN TREE

Dedicated to the founders of the Save-the-Redwoods League, Madison Grant, John C. Merriam, and Henry Fairfield Osborn



SCIENCE IN FIELD AND LABORATORY

American Museum Activities—Expeditions—Meetings of Societies
Other Museums—New Publications

EDITED BY A. KATHERINE BERGER

ASTRONOMY

THE AMATEUR ASTRONOMERS ASSOCIATION will continue to hold its meetings during the month of May, and all those interested in the subject of Astronomy are invited most cordially to attend these meetings which are held in the large auditorium of the American Museum of Natural History at 8:15 on the first and third Wednesdays of each month, except during June, July, August, and September. On May 3rd Mr. Stansbury Hagar, noted astro-ethnologist, will speak on "Evenings with American Indian Astronomy and Tradition," his lecture to be illustrated by slides. On May 17th Dr. Clyde Fisher will speak with the motion pictures of "The Einstein Theory of Relativity." The Annual Meeting will be held on this date, also.

The first meeting in the fall will be on Wednesday, September 20th, when Dr. Clyde Fisher will speak on "Meteorites and Meteor craters."

EDUCATION

THE Bear Mountain Trailside Museum.—May 1 marks the official opening of the American Museum's Nature Trails and Trailside Museums at Bear Mountain on the Hudson. During the past winter many new features have been added to the fifty-seven acre area. Three new buildings have been erected by the Commissioners of the Palisades Interstate Park under the direction of Major William A. Welch, general manager and chief engineer, and Mr. John Tamsen, park superintendent. The entire Bear

Mountain Bridge approach to the museums, trails, and zoo has been landscaped by Mr. Raymond Adolph, Park Forester.

The former wooden crafthouse and garage have been replaced by attractive buildings made of native stone. In addition, a new Geology Trailside Museum has been erected, also constructed of native, rounded boulders selected from various sites throughout the Park. The new museum will house an exhibition and working demonstration of the minerals and rocks of the Bear Mountain region, an area rich in geologic story. Relief models, reference collections, and a library will be placed at the disposal of visitors. The new museum interior consists of a large, well lighted laboratory and an exhibition room. The Geology Museum may be viewed from the Bear Mountain Bridge.

An enlarged and much needed parking space has been provided to accommodate fifty automobiles. More than one half mile of water pipes, which were previously exposed, have been buried to a depth of three feet, thus improving the appearance of the nature trails and insuring a constant supply of water during freezing weather. This later work employed some fifty men for a month and necessitated blasting of bed rock ridges in many sections.

New stone steps and bridges have been built at several points along the main trail where walking was formerly difficult for visitors. A new approach has been made to Geology Point overlooking the Hudson River. A rustic ramp now



THE LONG BEACH, CALIFORNIA, EARTHQUAKE

As it was recorded by the seismograph at the American Museum on March 10, 1933

leads directly from the Trailside Museum to the point where a monument is erected in honor of Stephen T. Mather, founder of the National Park Service. The memorial consists of a large bronze tablet affixed to the side of a seven-ton boulder which required heroic effort on the part of the men who moved it from a considerable distance. The monument will be dedicated in May during the occasion of the National Conference on State Parks to be held at Bear Mountain Inn near by and will be unveiled by Mrs. Franklin D. Roosevelt.

Through a fund, provided by the Park Commissioners, the American Museum has been able to appoint Mr. H. T. Chishlom, since the first of March, to assist with the dismantling of the old buildings and to move all equipment and materials. Mr. Chishlom has also redecorated the interior of the original Trailside Museum.

Mr. William H. Carr, director of the Bear Mountain Trailside Museum, represented the American Museum of Natural History in the plans for all new additions to the Trailside Unit. In March Mr. Carr went to Albany to enlist State interest in the museum project. He described the work to Governor Herbert H. Lehman and to the Hon. Lithgow Osborn, Commissioner of Conservation of the State of

New York. The conference was made possible through the kindness of Rev. Charles P. Bispham of Suffern, New York.

The current year will be the seventh season of operation of the Trailside Museum.

COMPARATIVE ANATOMY

"MESHIE," pet chimpanzee of the department of comparative and human anatomy, frequently takes luncheon in the Museum restaurant and is equally popular with children and adults.

DOCTOR GREGORY's work on "Fish Skulls: A Study of the Evolution of Natural Mechanisms" was published early in April in the *Transactions of the American Philosophical Society*.

DOCTOR GREGORY will give three lectures on May 29th, 30th, and June 1st, at University College, University of London, on "Man's Place Among the Anthropoids."

HISTORY OF THE EARTH

THE LONG BEACH, CALIFORNIA, EARTHQUAKE.

The earthquake, which shook southern California at 5:54 P.M., Pacific time, on March 10, 1933, was recorded on the seismograph at the American Museum beginning at 9:10 P.M., New York time, as noted on the accompanying seismograph record. This record is divided into three phases, first and second preliminary waves and main waves. These features are characteristic of all earthquakes originating more than 660 miles distant from the recording station. In the Los Angeles area more than 20 after-shocks were felt during the twenty-four hours following the initial shock. These after-shocks were of such small intensity that they were not recorded in New York. In California an area over 200 miles long and 30 miles wide was affected. The apparent location of the quake, as determined by various seismological stations, was in the San Pedro channel off Long Beach, California. Slipping of blocks of the earth's crust along submerged fault lines was the probable cause. The number of dead reported on March 18 was 119, and the damage to property was estimated at \$75,000,000.

A comparison of the seismograph records made at the American Museum by the March 10, 1933, Long Beach quake, and the June 29, 1925, Santa Barbara quake, shows that these two temblors caused the seismograph needle to swing to about the same degree of amplitude. Although each quake did considerable damage locally they were only of moderate intensity when compared with some registered quakes from other regions.

These facts would suggest either that the quakes originated but a few thousand feet below the surface of the ground, or that there was only partial adjustment of the stresses and strains that caused the earth blocks to move. Because, however, of the number of lives lost and the great property damage, the Long Beach quake will rank as one of California's major earthquakes.

This earthquake was not unexpected by some seismologists. A moderately severe shock, centering at Whittier, was felt in the Los Angeles region on July 8, 1929. A quake which partly destroyed buildings in the Inglewood section was felt on June 21, 1920. The Los Angeles region, however, had not suffered a large earthquake in 78 years. Historical records show that great earthquakes occurred in this region on July 28, 1769, October, November, 1852, and July 10, 1855. The indications are that these large quakes originated in San Pedro channel, the same area where the Long Beach earthquake occurred.—CHESTER A. REEDS.

THE ELLSWORTH EXPEDITION

THE 150-foot ship that will carry Lincoln Ellsworth to the Antarctic is being prepared for its departure from Norway about the first of August for New Zealand. The ship is to leave New Zealand for the Bay of Wales about November 1, and will arrive at its base about December 15. The expedition is planning a 3000 mile round trip non-stop flight over the Antarctic Continent.

MAMMALS

THE J. A. ALLEN HALL OF NORTH AMERICAN MAMMALS.—One of the effects of the economic pressure and the reduced budget has been to hold up active work upon the plans for the new Hall of North American Mammals. Until funds are available for the construction of cases in the new wing, it will not be possible to undertake any of the attractive groups which are contemplated for that hall. As a partial recompense to the public who would like to see our North American mammals as attractively treated as those of Asia or Africa, certain changes have been made in the present J. A. Allen Hall of North American Mammals. These alterations while comparatively minor in character and possible of execution by the maintenance forces, have greatly improved the general appearance and attractiveness of the groups.

All of the standing floor cases containing groups of local or New England mammals have been withdrawn to the Hall of North Asiatic Mammals where they will be consolidated as a special,

temporary exhibit until the time when the hall must be taken over for the mammals of Northern Asia. Groups and structures down the center have been removed to allow a freer passage of visitors through the hall, and only the two large groups, that of the moose and of the bison, remain in the central area. The Moose Group has been equipped with interior illumination, which adds brightness and life that the old group never possessed. The windows have all been closed by light-tight panels, and the number of glass surfaces with their troublesome reflections has been considerably reduced. It is believed that in this exhibition hall, which is one of the oldest in the Museum, installation of more modern exhibition practice will so raise the value of the groups that the public will now find new interest there.

THE NEW HALL OF OCEAN LIFE.—As this note is being written, the Hall of Ocean Life is receiving the final touches preliminary to the formal opening on May 1st.

This hall occupies an entire wing and is devoted primarily to exhibits of the great oceans as contrasted to the harbors and shallow seas. Because of the large size of the cetacean exhibits, much of the space in the new hall is taken up by skeletons and models of whales and porpoises, and for the adequate display of this type of material it was necessary to have a great, open hall without columns or interfering architectural structures. Not only are the exhibits in the Hall of Ocean Life large in a physical sense, but some of them are great undertakings in every sense of the word, and Doctor Miner's Coral Reef Group, which has been years in the building, is an assemblage of many complex exhibition problems needing much time for a successful solution. Some of the habitat groups of the pinnipeds, such as that of the walrus, are among the largest of the habitat groups in the whole Museum.

When this building was first turned over to the Museum, work was begun at once on the installation of the various exhibits. The skeletons and casts of cetaceans were hung from the ceiling, and several of the habitat groups of seals for the spaces under the gallery were undertaken. Continuous progress has been made in the hall ever since, but because of the demands of other halls upon the personnel of the department of preparation, important features of these plans have had to remain undeveloped, and it has not been possible to open the hall to the public.

Now there is a sufficient number of completed exhibits in the Hall of Ocean Life to warrant an immediate opening of the hall and it will be possible to allow the public access to the greater



IN THE NEW HALL OF OCEAN LIFE

Construction work on exhibits in this hall is progressing rapidly in preparation for its opening on May 1

part of the floor and balcony without hindering the work on the uncompleted exhibits. Barriers will serve to keep the visitors from such areas as the unfinished Coral Reef Group.

A more detailed account of this hall, the exhibits, the expeditions and the persons who have made the hall possible, will be given in a later issue of *NATURAL HISTORY*.

PHIPPS-BRADLEY EXPEDITION.—A second shipment of small mammals was recently received from the Phipps-Bradley Expedition. It included a splendid series of 395 specimens from Southeastern Angola. Collections were made at Mulando and Humpata, thus extending the collecting area of this expedition many miles to the south.

The collection contained a series of jumping shrews of two genera, *Nasilio* and *Elephantulus*, and a large series of the striped grass mice *Rhodomys* of a form new to the Museum. One of the most interesting finds was a specimen of *Zelotomys*, the second from Angola to be received by this Museum, the first having been collected by the Vernay-Angola Expedition. This strange, white-tailed rodent, with projecting incisors, has been taken in Kenya, the Eastern Congo, and Northern Rhodesia. The Museum specimens appear to be the first recorded from Angola and

the individual collected by Mr. Bradley is the most southern record.

In a letter from Lobito, dated January 27, 1933, Mr. Bradley states:

I was much set up by the prospect of numerous specimens at Mulando where I had heard that the large game abounded, but to my disappointment I discovered very few small animals despite a month's effort. There were elephant, lion, eland, roan, waterbuck, impala, lechwe, greater kudu, etc., in large numbers but practically no rodents. The only specimen unfamiliar to me was a short-tailed rat, and though I scoured the country and put bounties on their heads, I got but three, of which two were imperfect.

Humpata was better and I secured several varieties there. Now, having had a vacation in Lobito away from the torrential rains in the interior, I shall leave for Chitau next week. I had hoped to try the Mossamedes desert, but the big truck with dual rear tires is unsuited for sand and I have been discouraged to attempt it alone. Chitau is only 120 kilometers from the railroad and the resident missionary has offered to come for me, so I shall travel by rail and leave the truck in Lobito until Phipps arrives.

STUDY COLLECTION OF DOMESTIC DOGS.—The department of mammalogy has for some time been striving to procure a representative series of skins, skulls, and skeletons of the various breeds of domestic dogs. This series is to be used for study purposes by interested persons. Such a collection can be brought together only through the interest and generosity of the owners and breeders, and through their coöperation the Museum has been most fortunate in obtaining some of the best dogs of their representative breeds. Recently two remarkable dogs have been added to the collection. Mr. George Ryman has presented his well-known and beautiful English setter "Grouse" and the department has also received from Mr. Edwin H. Morris his noted Newfoundland "Whinfield Nell."

PYRENEES CHAMOIS.—Of special interest in the mammal collection of the American Museum are two Pyrenees chamois received in exchange through the generosity of Dr. L. C. Sanford. They were collected by Mr. Richard Meinertzhagen in the Pyrenees and are the first specimens of this chamois to be received in the Museum collections.

MARINE LIFE

FIELD WORK IN THE BAHAMA ISLANDS.—On March 30 Dr. Roy Waldo Miner, curator of the department of lower invertebrates, returned to the American Museum after a five-weeks' trip to the Bahamas. Chris E. Olsen, who had accompanied him, remained in the field for two weeks after Doctor Miner's return. Mr. Roswell Miller, and Mrs. Miller accompanied Doctor Miner during the first two weeks and took an important share in the work of this expedition. Mr. Miller's ingenuity and energy contributed greatly to its success. The trip was

made possible through the interest of several friends of the Museum.

The purpose of this visit to the Bahamas was for a final check-up on details of the Coral Reef Group now being installed in the Hall of Ocean Life at the American Museum. Doctor Miner and Mr. Olsen took with them samples of the coral which had already been painted and prepared for the exhibit, and checked these with the growing coral. They also compared specimens of fishes which have been prepared for the group with the living fishes.

The weather was excellent for diving, and after a few days of preparation, Doctor Miner and Mr. Olsen spent a large part of thirteen days working under water. Mr. Olsen actually took paints, palette, and canvas to the bottom of the sea and put the colors on the canvas with a palette knife. Later this canvas was used as a memorandum for a second canvas of the under-water scene, and on this the finished painting is to be based. Several days were spent working on the rocky cays, from which specimens of honeycomb pinnacle rock were removed. More than a ton was brought back to the Museum.

Mr. Miller and Doctor Miner took more than 4000 feet of standard motion picture film, and Mr. Miller took from 5000 to 6000 feet of kodachrome film.

Bahaman officials were most helpful to the expedition's work, Governor Clifford taking a particularly active interest in it.

OCEANOGRAPHY

DOCTOR WILLIAM BEEBE of the New York Zoological Society staff has recently been appointed research associate in oceanography in the department of ichthyology of the American Museum of Natural History. For several years he and his associates have been giving their attention to the study of marine and deep-sea fishes about the Galapagos Islands, at Haiti, and latterly at Bermuda, and meanwhile have been in close touch with the Museum's fish department. A good deal of their collected material has come to the Museum. In January the steel ball or "bathysphere" in which he made his record-breaking descents to ocean depths beyond the limit of daylight penetration, was exhibited for a time in Education Hall, and was of great interest to Museum visitors. It is from this bathysphere that the shadowy forms of large fishes very likely of species never captured or described, were seen,—one seen so clearly that Doctor Beebe has ventured to make it the type of a new genus *Bathysphaera*. Doctor Beebe's Museum appointment, then, merely makes official

a connection which has existed, in fact, for some time.—J. F. N.

REPTILES AND AMPHIBIANS

RECORD Alligator.—The American Museum has received from Mr. E. Ross Allen the largest alligator that has come to hand in recent times. The skin is well over 13 feet. It measured 12 feet 10 inches in life. It is planned eventually to mount this large specimen as a central figure in the Reptile Hall.

SCIENCE OF MAN

NEW PERUVIAN COLLECTION.—Last month Mr. George D. Pratt presented a Peruvian collection to the Museum, consisting of 113 pieces of clay, shell, feather, metal, and wooden objects, from the Nazca and Chimú sections of the coast of Peru.

Most noteworthy are the two feather pieces, one of which is illustrated herewith. The headdress consists of a circular cloth hat and mantle completely covered with feathers. A crest of feathers projects upward from the center of the cap. The crest is designed with a step pattern in deep blue feathers on a yellow background



FEATHER HEADDRESS FROM PERU

One of two feather pieces in a good state of preservation recently presented to the American Museum by George D. Pratt

bordered by red. The top and base feathers of the crest are pure white. The cap itself has a design in orange and white bordered with green. The attached mantle, which extends down the back, has two helmeted human figures with three digit hands and feet. The one (left) has a green body with reddish-orange face and finger tips; and eyes and mouth composed of a yellow circle with a blue dot center. The background is white. The other figure is on a reddish-orange background, while the figure is blue with yellow face and orange and blue eyes. Beside the mantle a narrow strip of feathered cloth hangs from each side of the cap. These are decorated with bands of brown, white, yellow, green, and reddish-orange feathers.

The large poncho, companion piece of the headdress, is covered with reddish-orange and blue feathers. Both pieces are in a good state of preservation. They are said to come from Chancay, north of Lima, on the coast of Peru. Similar headdresses in the British Museum and in the Mazzei Collection come from Ancon, Chicama, Chimbote, and Trujillo. Gösta Montell, in his study of "Dress and Ornaments in Ancient Peru" (Göteborg, 1929) tentatively dates these headdresses as Late Chimú, or, according to Philip Ainsworth Means' dating, from 1100 to 1400 A.D.

The pottery consists of 26 pieces of Nazca style and 11 of Chimú. The specimens are excellent examples of these two cultures. One from Trujillo with a carved-out design is a unique addition to the Museum collections.

A large wooden idol, with a painted red face, and four carved ceremonial staffs are included in the collection. There are two *atlatl*, or spear-throwers, one with a metal tip, and probably ceremonial. A wooden trumpet adds to our primitive musical instruments. Three minute carved wooden images, as well as examples of weaving implements, fill out this section of the collection.

The shell objects consist mainly of small ornaments, fish- and bird-shaped, as well as fourteen shell figurines, some delicately decorated with inlaid colored pieces. There are in all eight bronze figures, a bronze spoon, five copper beads, and some copper discs and pins. The metal section is augmented by a silver cup with a hammered design.

This collection has been placed on special exhibit in the Peruvian Hall.—W. C. B.

A MAYA TEMPLE IN MINIATURE.—A model of the Maya Temple of the Two Lintels at Chichen Itza, Yucatan, generously lent by Mrs.

James B. Murphy, has just been installed in the Mexican Hall. The constructor of the model, Mr. Gregory Wiggins, has enhanced its interest by carving figures of Mayas leading Mexican captives before a lady of high quality who is seated in one of the doorways. To give an idea of the dense jungle now covering most of Yucatan, the artist has shown foliage surrounding the temple.

The effect is very appropriate. The Maya of Chichen were subdued by Mexican invaders at the close of the Twelfth Century, and in the course of the wars it is to be expected that the precincts of their temples would be allowed to fall into neglect, since men would not be available for any purpose but war.

The architecture of the Temple is in typical Yucatan Maya style, of which another example, the Red House, also at Chichen Itza, is shown in an adjoining case. The model lent by Mrs. Murphy, however, is the first attempt at a "habitat group" to be shown in the Mexican Hall. By this worthy addition the Museum's collection of models of Central American architecture becomes one of the finest in the world.

The model of another notable building is now being constructed by Mr. Shoichi Ichikawa of the Museum staff. This will show the Aztec Temple of Tenayuca in the Valley of Mexico, and when completed will be perhaps the only model of Aztec architecture in the country.

NEW GUINEA ETHNOLOGICAL EXPEDITION.

The department of anthropology of the American Museum has recently received a report from Dr. Margaret Mead who has been engaged in ethnological research and the collection of museum material in New Guinea since the latter part of 1931. Doctor Mead writes that she has completed her work on the Yuet River and that the collections obtained there are being transported to the base for packing. She expects to move her base of supplies two hundred miles farther inland in the Sepik District to Abunti. Early in the year she was engaged in a rapid survey with a view to the selection of another locality for intensive study, for comparison with the groups in the Wiwiak District studied last year. Doctor Mead finds the conditions for ethnological research on the Sepik so propitious that she plans to remain in that district for some months to come.

HONORS

DOCTOR CLARK WISSLER, curator of the department of anthropology of the American Museum, was elected an Honorary Fellow of the Royal Anthropological Institute, London, at the meeting of the Council on January 24, 1933.

MUSEUM ECONOMY MEASURE

OWING to the reduction that the City of New York has made in the appropriations for the maintenance of the American Museum, the Trustees have been compelled as a measure of economy to close certain halls on alternate days, since with the curtailed force of floor attendants it is no longer possible to man all the exhibition halls simultaneously. The Museum will endeavor to keep all but four halls open on Saturdays and Sundays.

MEMBERS' DAY

THE annual Museum Members' Day is being held this year May 2 from three to five o'clock. The outstanding feature of the occasion will be the formal opening of the Hall of Ocean Life, the progress of which has been observed with interest on former Members' Days. President F. Trubee Davison will greet the guests, and the Museum staff members will guide them through certain sections of the Museum. Each member is privileged to bring two friends.

ART EXHIBITION

THE Second Spring Exhibition, now an annual event, of the staff artists of the American Museum was a revelation of variety. In addition to paintings, drawings, and sculpture, there were many ingenious pieces of craftsmanship.

The works of such well-known artists as William R. Leigh, Arthur A. Jansson, F. L. Jaques, Mrs. E. Rungius Fulda, James L. Clark, Otto Falkenbach, and John W. Hope shared honors with the younger group of painters and sculptors, including Dudley M. Blakely, Louise and John Germann, Ramon Bermudez, L. Ferraglio, and G. D. Christensen.

The exhibition resolved itself largely into a series of "one-man" shows, where, if one were compelled to choose from so rich a store of individual pieces of outstanding merit, one would give special mention to the portraits and landscapes of Arthur A. Jansson, Dudley M. Blakely, and the Germanns, the eerie trees of Mrs. Fulda, and F. L. Jaques's charming bird paintings, the animal sculptures by James L. Clark and Robert H. Rockwell, as well as the animated-looking restorations of prehistoric monsters by Falkenbach and M. Flinsch. Also the animal studies by James L. Clark, George F. Mason, and Mildred Clemens.

The craftsmanship honors were shared by U. Narahara's flowers and fruits in wax, the unique glass toys of Herman O. Mueller, the penguin andirons of Dr. R. C. Murphy, Dr. G. H. Childs' miniature animals, Dr. Robert T. Hatt's

iguana-skin book bindings, and the brass tooled clock face by T. W. Voter.

Underseas life was handsomely transferred to canvas by Dr. G. H. Childs and Chris E. Olsen, and in a series of tile designs by W. Hammersley Southwick, of which "Sea Garden" in gold on black was an outstanding example.

In lighter vein were the ingenious satirical caricatures by Robert Joyce as well as the caricatures of Museum personalities by Miss Margaret M. Matthew and G. D. Christensen. For those with a flair for modernism there were the industrial scenes of D. R. Celentano.

—ARTHUR OHLMAN

THE ROOSEVELT MEMORIAL

MR. WILLIAM A. MACKAY of New York was successful in the competition held to determine the award of the contract to paint three murals in the Memorial Hall of the Roosevelt Memorial Building. These will cover 5165 square feet of space. Twenty-five artists competed for the award, submitting from three to six sketches each.

MEETINGS OF SOCIETIES

ARRANGEMENTS are being made to hold the Fifth Pacific Science Congress in the cities of Victoria and Vancouver in June, 1933, under the auspices of the National Research Council of Canada.

AT the February meeting of the Explorers' Club, Roy Chapman Andrews was reelected president; James P. Chapin was elected executive vice-president; and Walter Granger, secretary.

THE LIBRARY

THE Library has been fortunate in procuring during the past few weeks a number of items of outstanding importance and interest. Among them are:

Ocherki Sievero-Zapadnoi Mongolii (Sketches of Northwestern Mongolia), by G. N. Potanin, St. Petersburg, 1881-1883, a three-volume work which contains, in addition to a diary of the journeys undertaken in 1876-1880, materials for the ethnography, physical geography, and topography of the country.

Russia, Mongolia, China. Being Some Record of the Relations between them from . . . 1602-1676, by John F. Baddeley, London, 1919.

These two rare works were especially needed in connection with the Museum's researches in Central Asia and their accession has greatly enriched the collections on this region.

Outlines of Chinese Symbolism, by C. A. S. Williams, Peiping, 1931, an alphabetical compendium of antique legends and beliefs as reflected in the manners and customs of the Chinese. It is well illustrated and forms an important contribution to our understanding of the Chinese, their literature, fine arts, industry and daily life.

The Book of Amber, by George C. Williamson, London, 1932, a most comprehensive volume which has resulted from many years of close investigation on the part of the author. It takes up the subject from the viewpoint of literature, nomenclature, history, mineralogy, art, sources, zoölogy, botany, in fact from every possible angle.

DURING February and March the following *Bulltins* and *Novitates* were published by the American Museum:

NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum:

Fellow

Rev. FRANK W. ABBOTT

Life Member

Mr. ROBERT STRUTHERS.

Sustaining Members

Mrs. F. TRUBEE DAVISON.

Messrs. GEORGE H. DEL GRELLA, H. A. WISOTZKEY.

Annual Members

Mesdames W. W. BELLINGER, SIDNEY BRADFORD GRANT, J. C. GUGGENHEIMER, ROSALIE H. KAHN, BENJAMIN PRINCE, H. GRANT STRAUS, M. G. WEILER, JR., HENRY D. WINANS.

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Rev. JOHN M. J. QUINN.

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Judge GEORGE DONWORTH.

Honorable GEORGE L. DONNELLAN.

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NOVITATES

- No. 596. James, Maurice T.—New Asilidae from Colorado.
 No. 597. Munro, H. K.—Some Dacine and Ceratitine Trypetidae (Diptera) from Africa in the Collection of The American Museum of Natural History.
 No. 598. Shoemaker, Clarence R.—Amphipoda from Florida and The West Indies.
 No. 599. Van Duzee, M. C.—New Dolichopidae from North America with Notes on Several Described Species.
 No. 600. Gudge, E. W.—A Second Barn-Door Skate, *Raja Stabuliformis*, with Pectorals Non-Adherent to the Head.
 No. 601. Matthew, W. D. and Mook, C. C.—New Fossil Mammals from the Deep River Beds of Montana.
 No. 602. Mook, Charles C.—Skull Characters of *Teleorhinus Browni* Osborn.
 No. 603. Colbert, Edwin H.—The Skull of *Dissopsalis Carnifex* Pilgrim, A Miocene Creodont from India.
 No. 604. Colbert, Edwin H.—The Presence of Tubulidentates in the Middle Siwalik Beds of Northern India.
 No. 605. Colbert, Edwin H.—A New Mustelid from the Lower Siwalik Beds of Northern India.

BULLETIN

Vol. LIX, Art. 9. Frick, Childs.—New Remains of Tri-lophodont-Tetrabelodont Mastodons.

BETH E. MORSE, FRANCIS I. NEILL, CORNELIA P. NELSON, PATRICIA P. NEWCOMBE, LENA Z. NEWTON, CLARA OLTMAN, LORETTA M. PIERCE, MARGARET E. SUMNER, MILLARD L. ROBINSON.

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Prof. Dr. W. H. HOFFMAN

Professors R. DOHRN, J. A. DRUSHEL.

Judge JOSEPH B. ROSS.

Honorable OLIVER M. DEIBLER, C. PORTER KUYKENDALL.

Rear Admiral CARY T. GRAYSON.

Messrs. MARION S. ACKERMAN, BOUDINOT ATTERBURY, HARRY L. BAILEY, WRIGHT R. BAKER, GEORGE H. BARLOW, 3D., JOHN HAMPTON BARNES, JR., MAYNARD BARROWS, DANIEL BECKWITH, HENRY Y. BECKWITH, JULIAN GRINSTEAD HERRY, HENRY BEYER, DAVID L. BILLINGS, WALDRON M. BISHOP, WALTER H. BRADLEY, JR., THOMPSON BRADSHAW, WARREN D. BREWSTER, M. V. G. BROWER, O. E. BUCKLEY, ARTHUR B. CARR, EUGENE M. CARR, JR., JOHN G. CONSAUL, C. M. COTTERMAN, RICHARD A. COURI, DANIEL POMEROY DAVISON, ENDICOTT P. DAVIDSON, F. TRUBEE DAVISON, JR., LUIGI DE SIMONE, STANLEY E. FLANDERS, ANDREW FORMICKELLA, H. GILBERT FRANCKE, JR., WALLACE JON FROST, CHARLES E. GREEN, FRED J. GREEN, ERNEST F. GRIFFIN, JOHN C. HAARTZ, LOUIS J. HALLE, JR., GEORGE M. HARTT, THOMAS HEGGS, AUBREY EVELYN HORN, I. S. HORNE, ALFRED H. HOWELL, J. A. HOWELL, GEORGE F. INGERSOLL, WILLARD W. KEITH, EDWARD W. KNIGHT, EWING BUTS KRAININ, FRANKLIN F. LANE, JOHN E. LAWTON, JR., FRED LUDKENS, HANS LUNDBERG, BURTON P. LYMAN, NORMAN MACKENZIE, MAX H. MATTES, RICHARD B. MAY, A. OSBORNE MAYER, MAYR MAYRSOHN, JAMES REID MCKEACHER, MERLE R. MEACHAM, HENRY E. MENDES, PETER MOCK, JAMES M. MORRISON, O. H. MULLER, JR., HALSTED HAWLEY MYERS, JOHN L. NEWBOLD, JR., J. KENDRICK NOBLE, JR., HENRY LEE NORRIS, JOHN POLACHEK, FRANK I. PRENTICE, ALFRED C. RATH, OLIVER C. REYNOLDS, FREDERICK H. RIKE, WILLIAM W. ROE, JR., E. W. ROGALLI, ARTHUR J. RONAGHAN, STANLEY H. ROOD, JOSEPH ROSENHEIM, DAVID ROTHSCHILD, E. P. RYAN, ERIC RYDBERG, HENRY A. L. SAND, L. C. SCARAMUZZA, SOLOMON SCHOENBERG, C. BERTRAND SCHULTZ, C. F. SCHULTZ, ALBERT CHARLES SCHWEIZER, R. P. SCHWERN, FRED SEACREST, G. WM. SENN, HUGH CHARLES SICARD, C. E. SKINNER, L. N. SLATER, GEO. B. SMITH, MILTON SNEDEKER, H. PHILIP STAATS, LEO STEHR, J. A. SWIZER, GEO. R. TAYLOR, WALTER C. THURSTON, JOHN B. TINNON, G. S. TOWNE, LADISLAUS TUMA, LEVERING TYSON, JOSEPH UNGER, DAVID M. UPIKKE, A. F. VANDELVEDE, JOHN STEWART VHAZ, S. J. VICKERS, ALBERT A. VOLK, EDMOND A. WARD, HERBERT, S. WARREN, GEORGE H. WARRINGTON, RICHARD A. WEAVER, DANIEL T. WEBSTER, CLAYTON W. WELLES, GEORGE T. WHEELER, HARVEY WHEELER, FRED W. WILHELMY, LEIGH WILLARD, F. J. WILLIAMS, EDWIN C. WILSON, RUSSELL J. WILSON, JR., CHARLES S. WITHERELL, W. H. YOUNG.



NEW PUBLICATIONS

The Western Pony. By William R. Leigh. Illustrated by the Author. 116 pages, 9½ by 12½. 6 full-page colored illustrations, 18 pen and ink drawings. Huntington Press, New York. 1933.

IT is most fortunate when author and illustrator are in perfect understanding but, when the genius of author and artist are combined in one and the same individual, an even greater harmony is expressed.

The six full-page illustrations in color, beautifully reproduced from Mr. Leigh's superb paintings, and the many pen drawings make the book an outstanding work of art, while the text gives us a colorful picture of the important rôle performed by the horse in the frontier life which is fast vanishing.

Mr. Leigh describes briefly the evolution of the horse, its extinction in America, and its reintroduction to the Western Hemisphere by the Spaniards four centuries ago.

The chapter "The Wild Horse and His Enemies" shows us how well suited to the needs of the equine stock are parts of our West and Southwest, where escaped domestic horses have assumed responsibility for themselves and prospered, while in prehistoric times indigenous wild horses had roamed in abundance over this same country and then, for some unknown reason, had become extinct. He describes most interestingly the resourcefulness of these feral animals in coping with their predaceous enemies, telling us of their many clever devices for protection or escape. Although these traits were undoubtedly inherited from earlier wild ancestors, they had not been exercised for untold generations during the domestication and protection of the horse by man.

Another outstanding feature of the book is an interesting and scientific discussion of the progressive movements of animals and their artistic representation from the viewpoint of a talented artist, who has not ignored the value of instantaneous photography which, after allowance has been made for photographic distortion, has added so much to our knowledge of animal action.

I must, of necessity, refer to the chapter, "Hunting the Grizzly." In the pack train "three or four" outworn and crippled horses, faithful servants of man, are forced to climb over rough mountain trails that they may serve as bear-bait or as food for bear-dogs. Mr. Leigh

tells us that this treatment is defended as being quite as merciful as that administered by the cougars and wolves. A hungry carnivore could hardly be expected to display a high degree of human altruism, but even he has no object in forcing his victim to climb a cañon before taking his meal on which his life depends.

Part of the outfit consists of a pack of dogs whose duty it is to trail and worry to distraction the unfortunate bear. A number of these dogs are killed and others badly wounded by the tortured bear, who asks only to be let alone. Finally, the bear is slain; all this, apparently, just for the thrill of the hunt. It may be said that the critic is no sportsman. Quite true. If the barbaric and bloodthirsty "sport" described in this chapter constitutes sportsmanship, then I welcome the accusation as a compliment.

But, lest I close in the worst of humor, let me mention one of the gems of the book where Mr. Leigh draws a contrast between the past life of the Indian pony and the present, and describes with sympathetic understanding and in a most poetic manner, the passing of the "West" with its pony, its cattle, its cowboy, and its romance.

—S. HARMSTED CHUBB.

Fighting the Insects. The Story of an Entomologist. By L. O. Howard. The Macmillan Co., New York, 1933.

AN autobiography of a great scientific leader, but more than that to hundreds of entomologists and scientists throughout the world, because to everyone who has had the pleasure and honor of visiting Doctor Howard in his office, at meetings, or wherever he might happen to be, this book will prove to be a continuation of the pleasant visits. To me the book means much more than a mere biography. It records the meetings of a scientific man with those of prominence in the world, with people in the public eye, with great scientists and great statesmen. To those who do not know the author the dominance of his personality will not be evident in the printed words, and something will be missed thereby, although there is pith aplenty from cover to cover. One feature of Doctor Howard's life as a scientist is missing, because he has made no mention, or at any rate has passed over lightly, the great stimulus he proved to be to young, unproven entomologists: the number

receiving encouragement, and ranking today among the leaders of their profession is unbelievably large.

It so happened that my mother wrote, largely from her mother's dictation, the story of her mother's life, and that later she wrote a long account of her own. So this little story of mine, added to the two that my mother did, carries the personal records and family incidents through three generations, covering considerably more than a hundred years, since my grandmother was born in 1800 . . . and if anyone wishes to consult these manuscripts for historical or other reasons, I am sure my daughters will be very willing.

So says Doctor Howard in his introduction, and his words reveal truly that much of history is bound up in *The Story of an Entomologist*. Ignoring all but historical incidents directly connected with entomology, it is sufficient to mention the recording of the great strides that have taken place in the study of insects and human welfare during the present century. A little more than thirty years ago it was discovered that malaria was transmitted by mosquitoes, and in the intervening years it has been found that many of the worst scourges of mankind are carried by insects. How recent these discoveries really are may be gleaned from a letter from Dr. Walter Reed, (1901) part of which is quoted:

The mosquito theory for the propagation of yellow fever is no longer a "theory" but a well-established fact. Isn't it enough to make a fellow happy. *Anopheles* and *Culex* are a gay old pair! What havoc they have wrought to our species during the last three centuries!

Knowledge of insects may sometimes prove advantageous. Doctor Howard demonstrated this during a visit to San Antonio, Texas, the year following the World's Fair at St. Louis. At that time there was an outbreak of yellow fever at New Orleans, and it so happened that at the time Doctor Howard was in San Antonio there was a convention of some sort and the hotels were full. The clerk said he could give him a cot with three other men and Doctor Howard accepted. As he was preparing for bed:

I heard footsteps in the hall, the door opened and in came the other three men. I pulled out my hand lens, knelt on my cot, and began to examine a spot on the wall.

"What are you doing?" said one of my roommates.
 "I have just found a yellow fever mosquito!" I said.
 "My God!" said one of them, and they collected their luggage and left, leaving the whole room to me.

In Italy, while inspecting malarial work with Senator Grassi, an eminent entomologist:

"Guiseppe, here, is a great anarchist," and then to Guiseppe, "This gentleman is an American." Whereupon I remarked, "Yes, and we have no anarchists in America." To which Guiseppe replied, "You are mistaken. I have a cousin who lives in Chicago, and he is a much more pronounced anarchist than I am!"

Thousands of visitors to the Cosmos Club in Washington will find recounted incidents of which they are well aware. A whole chapter is devoted to the Club and it creeps in throughout the story. The American Association for the Advancement of Science also receives a chapter and an interest-

ing one it is, too, especially to the numerous members of this organization. A story on pages 221-22, will prove enlightening, but I cannot quote it in full, and, so, must leave it for the reader. It has to do with the investigation of the Association by the Post Office Department!

A great artist once told Doctor Howard, who had protested that he was working with such little things, "that you do it in a big way, Dr. Howard," and I can do no more than paraphrase that remark and close by saying about *Fighting the Insects*: You have done it in an interesting way, Doctor Howard.—C. H. CURRAN.

Lions, Gorillas, and Their Neighbors. By Carl and Mary L. Jobe Akeley. Pp. xviii, 260, pls. 21. Dodd, Mead & Co., New York, 1932.

LIONS, *Gorillas, and Their Neighbors*, by my old friends, Carl and Mary Akeley, has been a joy to read. There is not a dull spot in it. But for all that, the stories told and the scenes described are truthful and accurate pictures.

Some of the twelve chapters have been compiled by Mrs. Akeley from Carl Akeley's early field notes. Others are stories which Carl Akeley was wont to tell his friends. Still others recount the experiences of Carl and Mary Akeley on their last journey together in Africa. The various narratives are simply told, without any of the embellishments that are only too common in books on African travel. The reader, whether he be familiar with African scenes or not, has a feeling that truth has never been sacrificed for the sake of making a good story better. To one who has had the privilege of having been in Africa the descriptions bring back glorious days and nights in that greatest of all game countries.

In three chapters on lions, the reader is not only given an interesting narrative, but much information on these magnificent animals. In another chapter, the hunting of buffaloes with the attendant difficulties and danger is described, while two chapters on mountain gorillas give the reader an excellent picture of the great apes and their habitat. Carl Akeley knew leopards. In a chapter on these animals written by him, he described vividly his single-handed battle with the one he killed with his bare hands. Needless to say, the reader does not put this book down during this chapter.

The illustrations, mainly from photographs by Carl Akeley, are excellent, and are supplemented by a series of sketches by Arthur Jansson. There is a sufficiently comprehensive glossary of Swahili words used throughout the narrative. Altogether I can heartily recommend the book as being authentic and very readable.

—WILLIAM J. MORDEN.

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The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor



A. KATHERINE BERGER
Associate Editor

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STELLER'S SEA LIONS IN AN AMERICAN MUSEUM GROUP

These sea lions often haul out on rocky beaches and are active enough to clamber over good-sized rocks and ledges. This museum presentation permits a glimpse of these big sea lions through one of the grottos or rocky arches which are not uncommon on the Pribilof Islands

(See "Glimpses into the Hall of Ocean Life," Page 365)

JULY-AUGUST, 1933



AUGUST ON FIRE ISLAND BEACH

Notes on the Natural History of an Almost Primeval Seashore

By ROBERT CUSHMAN MURPHY

ONE by one most of the barrier beaches off the south shore of Long Island have been joined with the mainland by track and motor-causeway across the creeks and meadows. That this has resulted in the greatest good for the greatest number can be doubted by no one who spends an August day in the Jones Beach State Park. From here westward to Coney Island, mankind's appropriation of the ocean front has been in varying degree completed, the product likewise varying according to the motive, aim, and taste responsible for the growth of each section.

To eastward of Fire Island Inlet, however, lies a summerland which is still frontier. The longest continuous reach of barrier, the natural breakwater between peaceful lagoons and the Atlantic, Fire Island Beach extends—mostly roadless, trackless, isolated, and alluring—for twenty-five miles to the new Moriches Inlet. Thence under other names it goes on toward West Hampton, where the bays narrow, and where for the first time one finds thoroughfares leading from sand to soil. Settlements, small and far between, dot the beach; nevertheless, much of it remains as if in unworldly trance, which began in the time that the

Indians vanished and now stands in danger of an unhappy awakening whenever the rush of "development" arrives. The beach has infinite solace for both bodies and souls; it affords not only the usual charms of an unspoiled seashore but also features so rare in our northern latitudes that they are in the nature of wonders. It is high time, therefore, to take counsel and to plan. The larger the human population destined to make use of Fire Island Beach, the more urgent it becomes that the face of nature be kept with as much as possible of its pristine complexion, instead of being first blemished and afterward restored with make-up.

On the map, the western end of Fire Island Beach seems very close to the metropolitan area. The tip of it, moreover, has not altogether escaped the curse. But when in August, 1932, I came to Point o' Woods, which is but six miles east of the Inlet, there was a sense of remoteness smacking of Nantucket in the old days. No roads, no motor cars; oil lamps as the source of illumination in most homes; a single telephone, in the Coast Guard station, which may be used by residents for emergency calls to the mainland; supplies and luggage hauled



LOOKING SEAWARD

One of the finest of Atlantic sandy beaches, practically devoid of shingle or pebbles, as seen from the steep wall of the first dunes

from dock to cottage in toy "express wagons," with which every household is equipped. So, almost within the long evening shadows of New York skyscrapers, has simplicity been held fast, while to eastward stretches a wilderness and a land of surprise. The symbols of the outside world may still be within sight and sound. To southward the "Bremen" passes, hull down, with her two stacks looming up enormously; the smoke of an engine, five miles across the bay, climbs the northern summer sky like a thunderhead; army combat planes drone back and forth high above the foam, in pursuit of a bomber which tows a bag-target, and the far-away patter of machine guns mingles with the roar of the surf. But in Point o' Woods, shut off from all distraction by an hour's trip on a miniature ferry-boat, life runs its quiet course, and by a ten-minute walk you may find yourself equally alone on a resounding beach, or in a marsh lost amid dense stands of oak and pine, or under the umbrageous gloom of hollies which have a mythic unreality in modern, despoiled Long Island.

Just how old the Fire Island Beach may

be, nobody has yet determined. Wave action tends to excavate the same forms beneath the ocean as on exposed shores, and the barrier originated through the breaking in shallow water of rollers too large to travel all the way to the mainland. The tossing of sand from these outer breakers on to the landward side of the submarine cut produced first a bar, and then a chain of islets which eventually fused to form a continuous beach. Its present equilibrium is the result of a ceaseless contest; the eroding forces, such as the direct assault of storm waves and the tidal currents between ocean and lagoon, work toward the destruction of the barrier, while débris carried by longshore wind-made waves tends to build it up along the ocean side. Whether it is now gaining or waning, or even whether the entire beach is moving in the direction of the mainland, is not certainly known. To man, a creature of short life and short memory, the broad area just east of Point o' Woods, with its high dunes, luxuriant vegetation, and aged trees, has all the earmarks of permanence and stability.

A cross section of the barrier where it is

widest and most variegated shows five distinct belts between ocean and bay. These are:

1. The strand.
2. The back-beach dune, which is regular and wall-like.
3. The broad interdune trough or swale.
4. The high inner dunes, which are in places double or complex, and which here and there continue in the form of isolated mounds clear across to the bay shore. These dunes may be completely wind-formed, or the main tier of them may represent an older shore-line. In any case, they are now well covered with plant growth.
5. Low, flat land between the inner dunes and the bay, mostly forested but broken by a chain of marshes. Where the latter abut upon the bay, they become brackish and support some typical salt-marsh vegetation.

The plant life of the barrier naturally has a distribution correlated with the land formations. In a broad sense, the vegetation is of two sorts, one being made up of true seaside plants, which the botanists call halophytes, the other of the

continental coastal plain flora. The latter includes, of course, all the trees and even such familiar shore shrubs as beach plum and bayberry.

On the upper strand, beyond the line of high tide but well within the swash of storm waves, the plants begin. At least six species grow on the stark sand below the cutbank of the first dunes. The rare little coast amaranth here spreads a medallion which looks like glazed and richly colored porcelain. The leafy stems of seaside sandwort, half buried in drift, stand up like elfin pagodas. Gray clumps of the dusty miller, scattered wisps of dune grass, and growths of sea-rocket and seaside spurge, complete the list of land plants that go down to meet the spume.

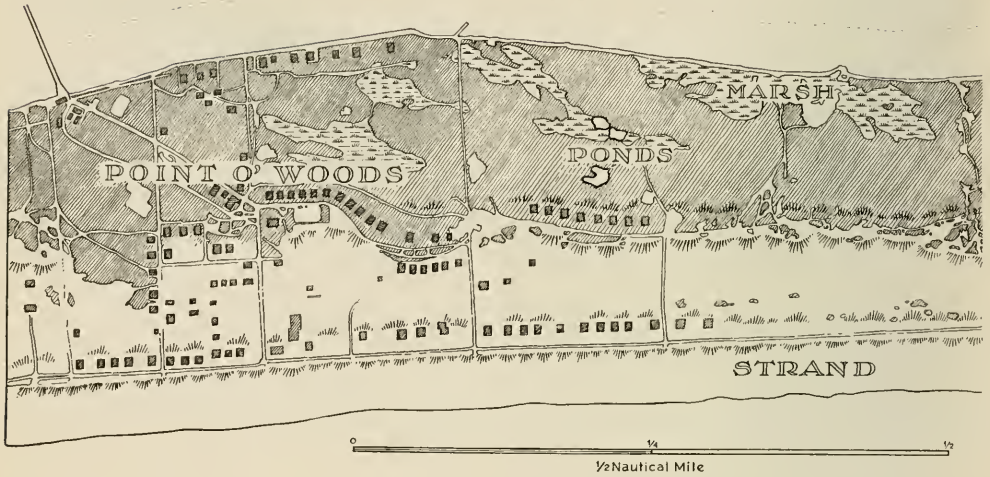
While all seem equally at home on the Fire Island barrier, there is one which is an immigrant and which no Shinnecock or Poospatuck could have found when the beach was the range of redskins. This is the dusty miller (*Artemisia Stelleriana*), a native of the Asiatic coast, which escaped



THE EDGE OF THE BAY

Across the barrier from the scene on the opposite page, showing clumps of shadblow, and drowned stumps below the level of the bay strand

GREAT SOUTH BAY



POINT O' WOODS SECTION—

Drawn from data supplied by the New York State Park Commission. The several zones of the barrier, as described in the text, are indicated

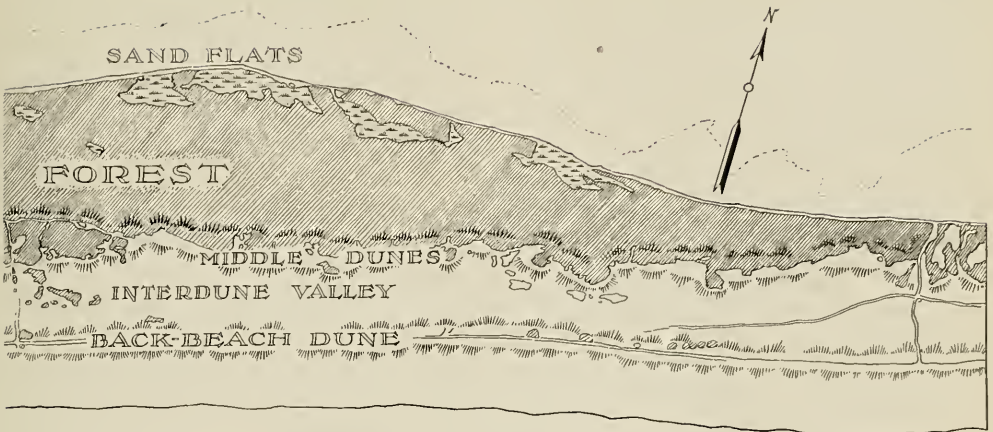
first from Swedish gardens to Swedish beaches, and later repeated the same history in North America. While it is now found in many inland localities, such as the shores of lakes, it thrives most abundantly along our Atlantic beaches from Maine to New Jersey, a coast which is the climatic counterpart of its original home.

Climb the bank of the back-beach dune into a new and more luxuriant plant association. Here the dune grass is rank and dense, hiding the blossoming beach peas, and scattering seed to the August wind. Extending up the landward slope are many plants most characteristic of the interdune swale, such as the seaside goldenrod, poison ivy, Virginia creeper, and low masses of bayberry. In the swale itself are all the plants yet named, except the few confined to the strand, together with panic grasses, pinweed, saltwort, starry Solomon's seal, wild wormwood, the gray lichens called "reindeer moss," hawkweed, thistles, and shrub growths of red cedar, rum cherry, beach plum, winged sumac, huckleberry, and pitch pine, some of the clumps being bound into thickets with catbriar and other vines. Here, too,

the beach heather and the bearberry form solid beds on mounds toward the northern side of the depression, and the bracken curls, rattles, and turns brown in the August drought.

On the inner dunes one meets with vegetation of different appearance or composition from that of the swale. In the first place, plants already noted put on new style. The beach plum, sumac, high-bush blueberry, and bayberry form tall, stout shrubs. Some of the plum trunks are four inches thick. Pine and red cedar lay off their bushy habit and become trees. The crest of the highest dunes marks the edge of a jungle, with close banks of wind-planed holly and post oak, the latter assuming the stunted form of scrub oak, so familiar on the mainland pine barrens. From the dune-tops, thirty-five feet or so above sea level, one can see that the roof of the forest in the depression on the northern side has also been planed to general uniformity by the winds. Only more or less gaunt pitch pines project here and there above the flatness.

The slope is abrupt from the high dunes into the sheltered and shadowed land



ATLANTIC OCEAN

—OF FIRE ISLAND BEACH

The richest part of the "sunken forest" plant association is near the division of the chart, 18 telephone poles east of the Point o' Woods boundary

toward the bay. Wherever this northern zone of the barrier is rolling, the vegetation is likely to be somewhat open, consisting of red, black, and post oak, pine, and red cedar, mingled with shrubbery and undergrowth. But in low flats and pockets behind the higher dunes are remarkably close stands of both ancient and younger trees, banked with impenetrable masses of catbriar and bound together by twisted lianas of grape and poison ivy. In Point o' Woods parlance such places are known as "sunken forests." The component trees, in approximate order of abundance, are holly, tupelo, sassafras, rum cherry, oaks, large pitch pine, red cedar, and red maple. The first three form a few groves to the practical exclusion of other trees. In some places, too, the tangle of vines is lacking, and there is a soft carpet of ferns, wild sarsaparilla, and Canada mayflower. The puddle hollows run into muskeg, with sphagnum at their centers. Such spots are doubtless kept moist by seepage from the dunes.

The forest floor is dark with the tough, fallen leaves of holly and tupelo, and very little light filters through the canopy above.

It is cool and humid in such places, even at summer mid-day when the atmosphere is scorching on the dunes a hundred feet away and less than forty feet higher. The trees are all rooted in quartz sand, as is apparent wherever a fallen trunk has torn up its foothold, but the surface blanket of mould is fairly thick. In most places one can dig through about six inches of black humus before the grains of sand become appreciable.

The long boles of the trees in the sunken forest make a picturesque and contrasting scene. Most striking are the yellowish-gray hollies—the last word in grotesquerie of stem and branches—twisted, gnarled, and knotted, parting and fusing again like island olives. Cloven trunks are not uncommon. Some of the hollies have diameters of ten to twelve inches, breast-high, and a height of thirty-five feet.

Then there are the gray, mosaic-barked trunks of the tupelos, averaging somewhat smaller, but even more sinuous or crooked, a coastal character rather than one belonging to the species. The oak bark, except that of the post oak, looks black in the dim light. The sassafras trees have

trunks of a rich brown, and these, particularly in the younger individuals, are also contorted and vinelike from the whimsy of sea winds. Many have diameters of fifteen inches, which is close to the usual maximum on Long Island.

A few of the pitch pines have seventeen-inch trunks, with nine- or ten-inch lower limbs. The largest of the red cedars are mostly dead and white, burgeoning toward their tops with the rich foliage of poison ivy, which slays not with its sap but with the more subtle venom of its heavy shade.

Running through this flat land, which averages only a few feet above the level of the water, are the marshes. Most of them open on the bay shore, but others are wholly surrounded by forest. The flora includes cat-tails, sedges, ferns, cranberry, swamp rose, poison ivy and poison sumac, azalea, swamp St. Johnswort, pink rose-mallow, and young pitch pine. Older pine appears to be encroaching upon the margins, and is especially thriving upon the needle-covered "island mounds" which are doubtless conquered dunes. The oak woods, likewise, are most

luxuriant at the verge of swamps. Sporadic trees of the "sunken forest" association grow right across to the bay, a few good-sized hollies standing within three paces of the present edge of salt water.

There remains a bulk of bushy and

shrubby vegetation which fills the space among the trees and helps to frame the marshland. This includes many of the species already named. Conspicuous everywhere, moreover, are the tall clustered stalks of shadbush, practically all of which are wavy, unlike inland plants of the same kind. The bark of the shadbush abounds with pits made by the yellow-bellied sapsucker, a fact suggestive of its kinship with the apple. Living clusters are found quite to the brink of the water on the bay side, and many groups of the decayed stumps, together with the bleached skeletons of post oaks, are among

the evidences of local subsidence or undermining on this shore. Large clumps of shadbush are, indeed, the principal accent on every little point along the bay, as though the bundles of its roots were a bulwark against erosion by water. Between such clusters, bayberry, huckleberry, sweet gale, beach plum, chokeberry, yarrow, wood sage, Virginia creeper, blackberry, catbrier, the inkberry or smooth holly, and an occasional group of groundsel bushes and stunted oaks, combine to



HOLLY WITH CATBRIAR DRAPERY

This famous tree (*Ilex opaca*) has been well nigh exterminated throughout most of its old range on Long Island

make a thicket just above the narrow bay strand, where water plants pile up on the reddish or blackish sand.

The adaptability of some of the barrier beach plants is remarkable. Perhaps the poison ivy is the best example. On dry

sand, as in the interdune swale, the plant stands alone as a compact and vigorous bush-shrub, with a trunklike stem. On the inner dunes and along the bay, it forms jungle with the catbrier. In the forest it is a creeper and climber, running to the tops of the tallest trees and there sending out strong horizontal branches; in the swamps a trailing ground vine, bearing slender upright standards among the sedges and reeds. Altogether it is a successful and beautiful plant, ready for competition with all comers under every condition of soil, moisture, light, and even saltiness. Before August is old, it begins to unfurl a red banner, thus joining with the sumac, tupelo, and sassafras as early heralds of autumn.

Doubtless a word should be added about the eel-grass (*Zostera*), which is a plant both of the bay shallows and of trenches off the ocean beach. It is not, of course, an alga, but rather a terrestrial flowering plant gone maritime, and a member of the pond-weed family. Large areas in the bay which have recently supported dense growths of eel-grass are now bare, and on all hands one hears of a marked shortage in Great South Bay, as elsewhere along the coast from New England to the Carolinas. The fact has a serious bearing upon the supply of many creatures, from shellfish to wild fowl.

The Fire Island ocean beach is made up of pure quartz grains mixed with shell fragments; pebbles are extremely scarce. The daily contour of the lower strand varies according to the direction and force of the wind, and the nature of the organic material cast up leads me to the conclusion that a careful and prolonged record

of the jetsam, as correlated with meteorological conditions, would be illuminating.

From this point of view it is clear that the ocean is selective, not haphazard, with reference to what is washed ashore. Thus, on August 21, when the weather had moderated after two days of strong southerly winds, with high surf, the line of wrack was made up of countless bunches and strings of seed mussels. Most of them were attached by the byssus to threads of seaweed



A RIOTOUS PATTERN OF BRANCHES
Looking upward from the shades of the "sunken forest" into the tangled limbs and twigs of a tall holly

or bits of shell, but others were joined together by a rope made only of the byssal fibers. The individual shells were half an inch in length, or less, but the tide line was black with them for miles. Doubtless the preceding surf days, with many successive lines of breaking waves, had scooped them from their moorings.

Earlier during the month, and I believe after periods of gentle southerly winds, the principal flotsam on certain days had been the disks of jellyfish, as round and clear as magnifying glasses, or

again, the gelatinous clusters which resemble water-logged chrysanthemum blossoms and which are the egg masses of a squid. Still again, attention would be fixed by vast numbers of the shells of the sea clam, mostly immature examples, many of them drilled by carnivorous snails. The shells of the snails were sometimes mingled with those of their victims, but the sand-collars, which are the snails' manufactured egg-cases, usually appeared on the beach at other times, when they, in turn, formed the preponderating element of the jetsam. On August 29, following twenty-four hours of northerly winds, the drift was composed mainly of young rock crabs, tens of thousands to the mile. The point of these random and inconclusive observations is merely to emphasize the fact that on any one day some particular organism, rather than a miscellaneous aggregation, makes up the conspicuous spoil of the sea.

Referring again to the sea clams and drilling snails, the latter are cannibalistic as well as merely carnivorous. The victims of their own kind always have the hole in precisely the same position, on the convex surface near the whorl. Evidently the predator thrusts its foot over the whorl and operculum of its prey, taking the position in which it "fits" most conveniently, whereupon the grinding radula works always against the same spot of the shell. In a similar way, the clams are invariably drilled on the convexity of the valve, in a middle position close to the hinge. In such reactions we see the simple and understandable beginnings of more complex and mysterious phenomena, such as the ganglion-stinging of the spider-killing wasps, the tail-biting attack of the scorpion-mouse, or the snail-paralyzing prick which the everglade kite so accurately inflicts with its sharp bill.

Many shells of both clams and snails



SUN-FLECKED TRUNKS OF THE "SUNKEN FOREST"

Youngish holly, sassafras, and tupelo (*Nyssa sylvatica*), with prickly bonds of *Smilax*. The forest floor is here covered with wild sarsaparilla (*Aralia nudicaulis*)



STALKS WHICH BEAR THE STAMP OF SEA WINDS

Shadbush (*Amelanchier*), of which two or more species abound on the barrier, rears its undulating stems against the sky over Great South Bay

show that the boring process had been interrupted before completion, leaving polished circular depressions exactly the size of the holes through which other mollusks had been eaten alive.

Following long-continued southwesterly winds, garbage occasionally floats ashore, to the shame of a backward metropolis. Bottles, here as everywhere else, seem to make up the principal harvest of the modern ocean. What perverse sense of neatness decrees that every cork and stopper should be carefully pressed or screwed into place before they are cast overboard? If it were not for that habit, they might still pave the bottom of the deep, but they would not strew the beaches by millions. I wonder whether hand-blown bottles, George Washington and pistol flasks of a former century, lie buried deeply under the bases of the first dune! Among thickets of the inner dunes I found bottles which had perhaps lain at

the surface for many years and which, through the effect of sunlight upon the manganese in the glass, had acquired the well known purplish opalescence of bottles long burned by the glare of deserts.

The lower strand of North Atlantic sandy beaches, and the waters inside the outer breakers, are proverbially poor in living creatures. Except for feeding shore birds, a few insects, small active worms, and such crustaceans as ghost crabs, the sand-fleas or gammarids of the intertidal tract, and the sand-bugs or hippas of the wave-wash, this joint strip of earth and brine forms far more of a graveyard than an environment for the living. No doubt the total insect fauna of the Fire Island barrier is a rich one, but many species are inconspicuous and many are there by accident rather than by choice. The insects most easily seen, I judge, are highly seasonal. In late summer there is certainly no trace of the

huge number and variety of beetles to be found along this same beach during June, washing ashore and crawling up the sands like shipwrecked mariners. Only a few cicadas and katydids among the woods and dunes are reminders that August is the peak of the social season for insects on the mainland. Small black and yellow wasps whisk and stamp about, making the sand spray from their feet; pale grasshoppers flutter down to the upper strand from the grassy places behind; and toward the end of the month the migratory monarch butterflies begin to pass, westward bound, sometimes flying against fairly strong breezes.

During northerly winds there is abundant evidence of the presence along the ocean shore-line of hordes of small insects, which cannot be discerned by the eye. This is indicated by the habits of swallows and chimney swifts which, at such times, hawk back and forth over the wash of the waves and the breaking surf. It seems as though a veritable wall of wind-blown insects must be struggling to regain the land along this line, for under other weather conditions the birds never forage in the same place.

Northerly winds are, fortunately, rare on the barrier in summer, for it is only when such are blowing that mosquitoes and biting flies make a sudden and dire onslaught. Once, after three days of

breezes off the land, the so-called stable fly (*Stomoxys calcitrans*)—an insect which gives the house fly the quite undeserved reputation of biting before rain—made the strand practically unendurable to human

beings. This species breeds in decaying vegetation and is found the world over. It can bite through summer clothing or woollen stockings as effectively as on bare skin. On “mosquito days,” huge dragon flies gather in flocks along the Point o’ Woods paths, darting about on their beneficent quest.

Another and well known effect of off-shore winds is to lower the temperature of coastal ocean water. Southerly winds in August may be accompanied by



FOREST CONTORTIONISTS

Here shadbush and young sassafras (in the center) vie in a contest of sinuosity

swimming temperatures up to 70° F. or higher, the figure rising to a maximum as the offshore surface waters are blown on the coast. Twenty-four hours of winds from a northerly quarter, however, are sufficient to cause upwelling in the sea and to lower the thermometer to 58° F., while at the same time extremely warm water piles up along the opposite or bay side of the barrier. Possibly these temperature changes, in themselves, have something to do with the movements of such strand insects as the common cicindelid beetle.

Very typical among the Fire Island insects is this predacious tiger beetle (*Cicindela hirticollis*). It makes active short flights along the hot sand, and is

said to prey chiefly upon other insects. Most of the creatures I found in the territory over which it prowled were minute, leaping sand-fleas, but never was I able to prove that it captures these crustaceans. The gray and bronzy *Cicindela* moves to windward and, though it ranges to the waves' edge, it shows a negative reaction against being carried over water by the wind. This can be demonstrated by keeping on the windward side and badgering the beetles with handfuls of sand, thus driving them gradually down the beach. They prove wary and artful dodgers and, even when fatigued by continued barrages, they still contrive to work away from the water. The same reaction is shown under natural conditions when high winds and drifting sand herd them willy-nilly toward small points, with rills of tidal water to leeward, for here they cling in bands, showing great reluctance to cross even a few yards of water to the farther shore.

The tiger beetles are consequently most numerous on the ocean beach when the wind blows from the sea, and during days of northerly breezes they are scarce, if not absent. On August 20, after several hours of light northerly winds, I discovered what takes place,

and confirmed the observations on several later occasions when stronger off-shore winds were in progress. At

such times the beetles carry out their windward tropism to the extent of crossing the barrier beach *en masse*, flying over or through the forest belt and concentrating along the very narrow strand-strip of the bay, where they may come to number a score on each square yard of surface. On August 29, with the wind from the land, and bloodthirsty stable flies attacking the very heads of swimmers in the cold ocean waters, not a tiger beetle was to be found on the sea beach. But on the bay side they were legion. They were hunting jerkily among very small, soft-bodied sand flies, which they appeared to capture during quick bursts of walking, rather than in flight. The short darts they were forever making over the blackish sand were too rapid for the eye to follow or,

at any rate, to perceive the result.

Toads, mostly young, were the only amphibians I found on the Fire Island barrier. Ever ready to take advantage of them is the principal local toad-eater, the hog-nosed 'snake. Formerly abundant along the south shore beaches, the hognose is now scarce because of man's stupidity. Despite puffing and bluster, its gentleness and its infantile expression due to the retroussé snout give it a peculiarly inoffensive look, except to



A LOVER OF SUNSHINE

Bearberry (*Uva-ursi*), which forms beds of enameled leaves and red fruit on the dunes

the hopelessly prejudiced. It is one of the few snakes which cannot possibly be goaded into biting or striking. Its overt acts,

indeed, are confined to swelling up and to playing 'possum; at all ages it is a safe plaything for babies. The only other reptile I encountered was a single black-snake among the inner dunes.

Owing to the absence of salt meadows and large ponds on the part of the barrier near Point o' Woods, the region is not favorable for observing a great variety of migrant snipes and plovers, which would quickly swell an August bird list. During about twenty days' residence I saw sixty-six species of birds and the clear traces of several others (such as the signatures left by the sapsuckers during their spring and autumn tarrying).

August is the moon of moult and silence for most land birds, which increases the difficulty of discovery. Even such famous advertisers as oven-bird and redstart are then voiceless in the "sunken forests," and must be seen in the half-light to be known. But August is also the month of fledglings, which partly compensates. Birds with the unmistakable marks of childhood, whether of plumage, notes, or manner, were everywhere, some still in tow to their elders, others already at the stage of independence. They included the green heron, black-crowned night heron, marsh and sparrow hawks, common tern, kingbird, all the native

swallows save the rough-winged, chickadee, catbird, brown thrasher, robin, black and white warbler, yellow warbler, northern yellow-throat, oven-bird, redstart, red-winged blackbird, cowbird, towhee, and song sparrow. All but about seven of these, namely the night heron, sparrow hawk, and the swallows, may well have been hatched on the Fire Island barrier, as may likewise such others in my list as the least bittern, bob-white, piping plover, spotted sandpiper, black-billed cuckoo, ruby-throated humming bird, kingfisher, flicker, hairy woodpecker, crested flycatcher, wood peewee, blue jay, crow, Carolina wren, cedar waxwing, and Baltimore oriole.

Several of the resident song-birds were of more than passing interest. A pair of Carolina wrens, for instance, disregarded the midsummer rule of silence, for their singing and rattling could be heard at all hours of the day. The shelter of the "sunken forests," coupled with the tempering influence of the ocean, makes an ideal environment for this Carolinian bird. It is a sedentary species, which extends its range and numbers in the north throughout a series of years, only to be more or less wiped out by the first bitter winter. One would suppose, however, that Carolina wrens and hollies might exist together indefinitely in such a habitat as the barrier.

The abundance of the catbird throughout the whole wooded area of the beach is a revelation. Nowhere else have I seen such dense population approached. Here the species evidently finds optimum conditions.

CAT-TAIL SEASON

A secluded marsh on the barrier beach, with encroaching forest of pitch pine, oak, and other trees



THE WIND-BREAK OF
THE WOODS

Wind-planed holly, red cedar,
pine, beach plum, and bay-
berry mark the ramparts of
the inner dunes



The territories of the mated pairs must be extremely small, for in August a catbird was almost invariably in the picture wherever one looked among the trees and brambles, and the plaintive, susurrant whistle of the young was an unfailing forest note from daybreak until dark. On August 13 my younger son and I made a count of catbirds on a stroll between the Point o' Woods post office and the eastern end of the first forest patch, about half a mile west of Cherry Grove. With little or no chance for duplication we checked off 63.

The song sparrow made one of a trio with the towhee and Carolina wren to keep in full voice all through the dog-days. It nests closer to the ocean than any other land bird, building sometimes in beach plum clumps on the landward slope of the outer dune. Adults were carrying bills full of food to late broods until the very end of August.

Of the transients, the most entertaining, perhaps, was the migrant shrike, a bird which may be said to travel by telephone, for the coastal wires seem to be its route all the way from New Brunswick to the southland. From one pole to the next it skips by easy stages, yet rarely interrupting its journey for a longer stay than the time necessary for pouncing upon and devouring a grasshopper. Equally amusing was the sight of northern water-thrushes, apparently out of their element, catching small nereid worms on flats left bare by the falling tide of the bay shore.

Of the sea and beach birds one might

easily write too much. An adult gannet, bent on breaking records, reached Point o' Woods on August 21, almost as early as the expected flocks of double-crested cormorants. From among the dozen common shore birds, each as interesting as the others, I must restrict my reminiscences to the sanderling, which is by all odds the mascot of Fire Island beach. Well it is called "surf snipe," for the edge of the wash is where it spends its life. The prey for which it picks and probes is no doubt mostly diminutive. I had supposed that its bill and small mouth were adapted only to such food, but one day I frightened several birds into dropping the carapaces of hippas as big as their heads. They had pulled out the meat of these crustaceans, which are as round and tough as an olive. From this I suspect that the sanderlings had also plucked out the bright eyes of a sea-horse found high and dry, but still wriggling, at a spot from which they had just flown.

The sanderlings appear to be of two sizes according to whether their plumage is carried sleekly or whether the scapular feathers are raised. The latter mannerism they retain for long periods, giving themselves a fat, hump-backed appearance. Indeed, when most of their plumage blows forward, as they travel before

the wind at the edge of the surf, they look for all the world like miniature ruffs. They bicker a good deal among themselves, giving husky whistles as they chase each other, and they bully the stints and spotted sandpipers at every opportunity.

Sanderlings continue to wet their feet and to hunt for food until late evening, long after the spotted sandpipers have withdrawn to rest among the plant-covered inner dunes where they, alone of the shore birds, were born. The sanderlings appear to snatch their sleep in very short periods during any time of day, usually walking up as far as the first wave terrace for napping. Through glasses I often watched them patter up the strand, turn their bills down their backs, and rest thus for only a fraction of a minute before hastening again to the white water to resume feeding.

While dozing, a few of the birds squat on their bellies and draw down the head, with the bill pointing forward. Many more of them, however, make a pillow of their backs and poise on one leg, which is canted crosswise at a sharp angle to balance the body. In this posture they face the wind and swing like weather-vanes as it veers. If they are taken unaware, they seem loath to lower the

other leg even after they have turned their alert heads. Rather they are apt to hop on one foot for a few steps, then to stretch one dainty wing, in a characteristic Limicoline yawn, and finally to break into the run which ends with the whole gleaming flock in the air.

Such is a glimpse of the Fire Island barrier, but what an infinitude remains, unlearned, unseen! The proper destiny for extensive areas of the beach would be for them to become part of the New York State Park system, and this as soon as possible, before vandalism or development have destroyed the natural features. The "sunken forests" contain not only the last stands of large holly on Long Island, but also the northernmost considerable holly groves in eastern North America. Entire blocks of the barrier which enclose the choicest parts of the forest should be set aside as sanctuaries, with the ecological conditions undisturbed. Concessions, bathing pavilions, roads other than a single longitudinal highway, the clearing of underbrush, or any other "improvements" in such sections would be a calamity. Let us try to keep as they are a few bits of the most entrancing primitive territory to be found on the coast within a hundred miles of New York City.



TWO PREDATORS AND FOUR VICTIMS. THE SNAILS NOT ONLY DRILL INTO THE CLAMS, BUT ARE ALSO CANNIBALS



A Group of Alaska Fur Seal

GLIMPSES INTO THE HALL OF OCEAN LIFE

A Newly Opened Hall in the American Museum—the Largest of Its Kind in the World

By H. E. ANTHONY

Curator, Department of Mammalogy, American Museum

The direction of the Hall of Ocean Life has been, for some years, under a committee formed for that purpose and composed of a number of the staff of the American Museum and Doctor Townsend of the New York Aquarium. In the final preparations for the opening, work in the hall was under the direction of Curator H. E. Anthony. All mammal groups and all other exhibits, with the exception of the coral reef group and the shell collection, were installed under the direction of Vice-Director James L. Clark. The coral reef group, shell collection, and exhibits dealing with invertebrates have been under the direction of Curator Roy W. Miner.—THE EDITORS.

ON the first day of May, 1933, the Trustees of the American Museum viewed the new Hall of Ocean Life, and on the second of May the hall was opened to members of the Museum. There are still some vacant spaces in the hall destined for habitat groups, for murals, or for other special exhibits, but so many of the exhibition features have been completed that the hall should attract many interested visitors. The great coral reef group at the western end of the hall, now in the final stages of construction, is shut off from the rest of the space by a low fence over which the public may see some of the actual work of preparation.

The Hall of Ocean Life is the largest exhibition hall in the American Museum

and probably is one of the largest of its kind in the entire world. The floor is 160 feet by 130 feet, and the main panel of the ceiling, a beautiful patch of blue sky and white clouds, is 60 feet above the floor. No columns or supporting structures intrude upon the view, and the general appearance, architecturally, is somewhat suggestive of a cathedral.

It is now twenty-five years since the first expedition went out for material to be exhibited in the Hall of Ocean Life. Dr. Roy Chapman Andrews, in his *Hunting Whales with Gun and Camera*, and *Ends of the Earth*, has described the extended field work that laid the basis for the great collection of whales and porpoises destined for this hall. The mere physical storage

of such large specimens became an acute problem in the years preceding the erection of the hall, and various temporary sheds and shelters had to be built in area-ways or against outer walls of the Museum to accommodate them. It was a red-letter day when finally New York City approved the plans for the hall and voted the appropriation for the building.

The plans contemplated a great hall with ample space to suspend entire whales, with provision for large habitat groups of some of the striking forms of sea

life, and with a coral reef group as a spectacular exhibit to dominate one end of the hall. The late Dr. F. A. Lucas, then director of the Museum, had an active interest in these plans, for he was steeped in the lore of the sea and had a keen appreciation of the possibilities involved. Because the fishes were to be shown in a hall devoted to them alone, they were not to be featured in the Hall of Ocean Life, where the visitor, upon first impressions, might expect to find them. Architecturally the new hall was primarily

designed for exhibits of heroic size, and in this respect it is unique among museums of the world.

The visitor enters the Hall of Ocean Life through the Hall of Fishes, located in the south-east wing, and finds himself upon a balcony at the eastern end of the hall. His eye is irresistibly drawn to a striking scene of blue sky, white clouds, and rosy flamingoes, the above-water background of the coral reef group 160 feet away at the other end of the hall. Mr. F. L. Jaques painted this beautiful scene from studies made on the islands. Below the section of Bahaman seascape looms a great mass of coral rising from the floor to form a portion of a barrier reef. The multitude of living creatures responsible for the reef or residing within, from corals to fishes, provides a riot of color and a multiplicity of form which will later hold the



PREPARING FOR THE OPENING OF THE HALL OF OCEAN LIFE

When F. L. Jaques painted the attractive panel of blue sky and white clouds on the ceiling of the hall, it was necessary to erect a lofty scaffold of pipe which occupied most of the interior of the hall. When to this was added the tower ladders for hanging the whale skeletons to the supports some fifty feet overhead, the hall took on the appearance of a gigantic workshop



LOOKING WESTWARD FROM THE ENTRANCE TO THE HALL

In the center may be noted the coral reef group rising from the floor, where details under the water are shown, to the arch above where the painted background portrays conditions above the water-line. The flying bird overhead is suspended from the painted ceiling

visitor spellbound when he arrives before the group for a detailed inspection. Dr. Roy W. Miner has made five expeditions to secure this material, on one of which he brought back for this exhibit forty tons of coral alone. Ten years of preparation have already gone into the construction of the group, which has been carried on under Doctor Miner's direction by Mr. Chris E. Olsen and other highly skilled members of the staff of preparation.

Evenly distributed about the walls of the balcony are twelve large spaces for mural designs—lunettes in shape. At either side of the coral-reef background, also a lunette, is a mural showing running seas with schools of dolphins converging, in their plunging career, toward the center of the hall. These realistic paintings of dolphins are the work of Mr. A. A. Jansson.

Along the north wall a series of four

murals depicts typical scenes in the day of a sperm whaler, beginning with "The Chase," at the eastern end of the hall, and proceeding with "The Attack," "Towing the Carcass," and concluding with "Trying-out." On the south wall only three of the four lunettes have been completed; these show seascapes with "The Bowhead," "Finback Whales," and "Killer Whales Attacking a Gray Whale." These seven canvases were painted by Mr. John P. Benson under the direction of Dr. Robert Cushman Murphy, who made a trip aboard the New Bedford whaler "Daisy" in 1912-13. It is planned to fill the eighth of these spaces with a scene showing humpback whales at play, with one or more of the leviathans entirely clear of the water in the attitude of "breaching."

Suspended from the ceiling are casts and skeletons of whales and porpoises. A



A FINE, BIG STELLER SEA LION IN A PRIBILOF ISLAND SETTING

It is possible to view the sea lion group from two positions,—a main opening as shown here, and a smaller side opening as pictured in the frontispiece of this issue



LOOKING WESTWARD ALONG THE SOUTHERN WALL

Along the southern balcony railing hang two skeletons of large whales and a row of models of various species of porpoise. Along the balcony are A-cases holding the shell collection



ELEPHANT SEALS ON GUADALOUPE ISLAND

The pendulous proboscis of these animals seems fairly started on its way to become a trunk, especially when it hangs limply, as shown by that of the elephant seal at the right

: 6



LOOKING EASTWARD ALONG THE SOUTHERN SIDE OF THE BALCONY

The skeleton of the California gray whale occupies the foreground, and the conspicuous object near the center of the picture is a cast of a white whale or Beluga



VIEW FROM THE SOUTHEAST CORNER OF THE HALL

Across the skull of the finback whale one can see two of the mural paintings by John P. Benson illustrative of sperm whaling. At the western end (left) are the two murals by A. A. Jansson showing schools of dolphins

large sperm-whale skeleton, selected by Doctor Andrews as the largest catch of the season at the Japanese Whaling Station where he was collecting, is probably the most spectacular of these. The skeleton weighs several tons, and the suspension of so great a weight by cables of a size that would be inconspicuous necessitated calling in expert advice. Through the coöperation of Mr. Arthur E. Gaynor of John A. Roebling's Sons Co., a careful selection of airplane cable was made and a very considerable reduction in size was accomplished over the iron rods formerly used for this purpose.

The largest skeleton in the hall is that of a finback whale, which measured sixty-five feet in the flesh; there are also two other whales, the California gray whale and the Atlantic right whale, represented by skeletons. The largest model is that of the killer whale suspended over the balcony at the entrance to the hall. This

"wolf of the sea" is a strikingly marked cetacean, the males having a high, rakish, dorsal fin, and suggestive body lines denoting tremendous drive and power.

Just below the level of the balcony hangs a cast of a baby sperm whale, an animal probably but a few days old at the time of its capture. There is an interesting story connected with this whale, for it came to the Museum from the Gowanus Canal on the Brooklyn water front. The youngster had lost its mother and probably was driven by instinct to follow the first large moving object that came its way, which happened to be a steamer. It had been struck by a propeller but had managed to get well into the harbor, where it was captured by two longshoremen who led their prize into the canal and telephoned to the Museum. It was dead by the time the Museum could arrange to receive the specimen, and a truck delivered it in the flesh upon the tile floor of the

Hall of Ocean Life. It weighed several tons and undoubtedly is the only whale, aside from foetal specimens, to reach a museum in the flesh.

Other large casts or models include a giant squid, one of the favorite articles of diet of the sperm whale, a blackfish (a species of giant porpoise), a white whale, and a narwhal. A long series of models of the smaller porpoises extends along the south side, and a model of the pigmy sperm whale hangs near its large relative. There are skeletons of the narwhal, blackfish, bottlenose whale, Bowdoin whale, and Gray's whale to be found on the northern side. The cetacean exhibit is concluded with a case containing four scale-models, one inch to the foot, which stands on the main floor.

The collection of sea shells arranged in wall cases, A-cases, and flat-topped cases around the balcony is one of the most complete exhibition collections in existence. The nucleus of this exhibit comprises the D. Jackson Steward, Jay, and Crooke collections, while a recent conspicuous addition is the remarkable Frederick A. Constable Collection bequeathed by his widow. An especial rarity includes two perfect specimens of the beautiful *Conus gloria maris*, of which only ten or a dozen examples are known to be in existence.

Down the length of the hall, in two files, will stand glass floor-cases, of which two are now set-up, one with the small-scale models of whales already men-

tioned, the other with an exhibit of diving gear. In the latter case is shown a diving helmet and a complete diving suit with all the necessary equipment, such as hand pump, telephones, lines, etc. This gear has been used for the collection of material for Doctor Miner's coral reef group and for the making of undersea paintings.

On the main floor of the hall and under the balcony are the habitat groups with painted backgrounds. Some of these are very large,—the space occupied by the walrus group, for example, with a case front forty-five feet in length, being the widest in the Museum.



HUMPBACK WHALE IN THE ACT OF BREACHING

Any of the whales may, on occasion, leap out of the water or "breach," as the whalers call it. The humpback whale is apparently more fond of this exercise than are the other species, and one of the greatest of marine spectacles is the sight of one of these whales leaping clear of the water



THE SOUTHWEST CORNER OF THE HALL

In the floor case in the foreground are shown the different items in the equipment of a diver. Both the diving helmet and the regulation diving suit are shown, together with the pump to supply oxygen. Just below the mural of the leaping dolphins is a cast of the narwhal with its long ivory spear

The group of northern elephant seal, at the northeastern end of the hall, shows the beach at Guadaloupe Island off Lower California. This arid, uninhabited island rises sheer from ocean depths of nearly a mile and has only two or three narrow beaches upon which seals might haul up. In the spring of 1911 the "Albatross" Expedition of the American Museum, under the direction of Dr. Charles H. Townsend, visited Guadaloupe for general collecting and with some hopes of discovering specimens of the Townsend fur seal or the northern elephant seal. This fur seal had become almost legendary, for none had been reported alive for many years and the species was known only from four skulls which Doctor Townsend picked up on the beach of Guadaloupe in 1892. There was a suspicion that the elephant seals also were extinct or so scarce that none would be seen.

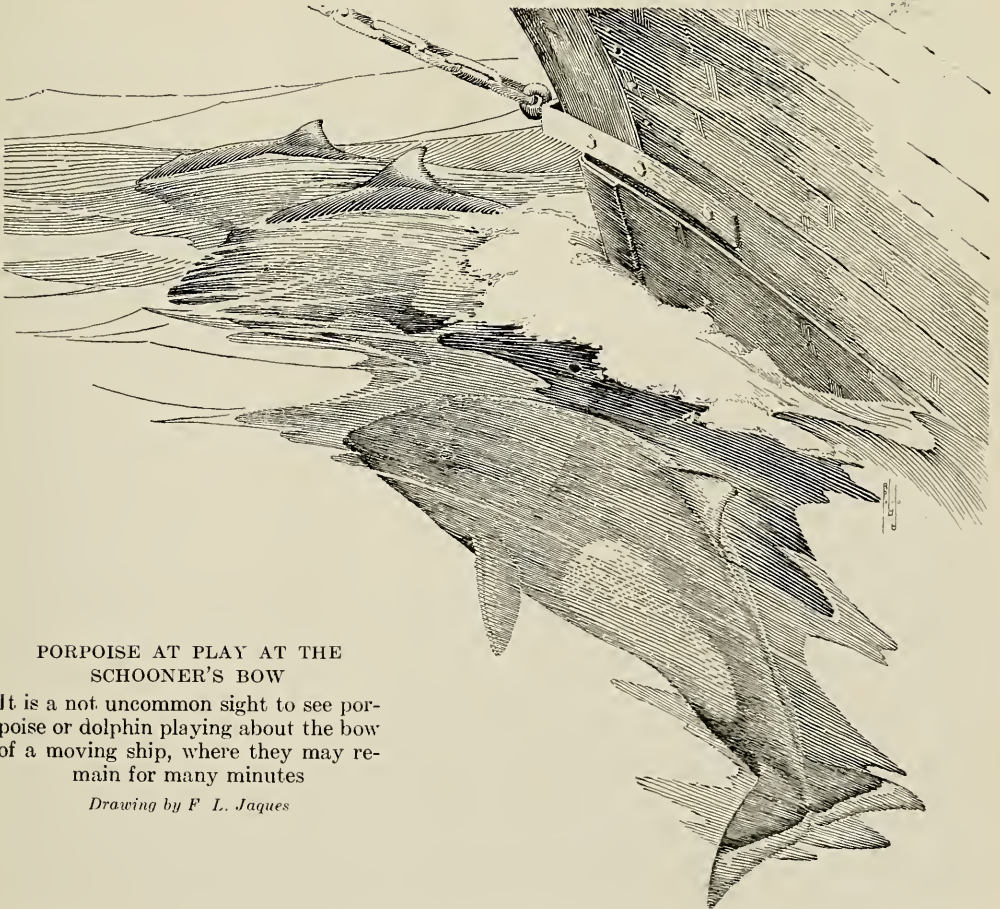
I was with Doctor Townsend on this trip to collect mammals, on my first American Museum expedition, and I still recall how thrilled we all were when the big elephant seals were discovered lying about on the brown beach. The long Pacific ground-swells pile up on this beach in foaming breakers, and the boat I was in capsized, distributing cameras, personnel, and all, impartially among the seals which thus saw men for the first time.

The big male seals inflate their pendulous muzzle, which suggests the trunk of an elephant, and threaten to overwhelm an intruder, but it is all bluff, and a sharp rap over the nose with a length of rope-like kelp stops the ponderous rush. These seals are harmless and deserve the protection which is now being given them by the Mexican Government. Formerly they existed in numbers along the western coast of Lower California

and off-shore islands, but were hunted almost to extinction for their oily blubber. Today this species is known only from the small colony on Guadaloupe Island but a closely related species, the southern elephant seal, is more abundant in the Antarctic on South Georgia. It is the southern animal that has appeared in recent years in one of our large circuses.

The expedition of 1911 saw no fur seals, but Doctor Townsend did not give up all hope, and during later years maintained an interest that eventually brought one of these long-lost animals to the American Museum. Much to everyone's surprise and delight, and out of an oblivion of nearly half a century, two live Townsend fur seals were brought to the San Diego Zoological Park by Captain Wm. O.

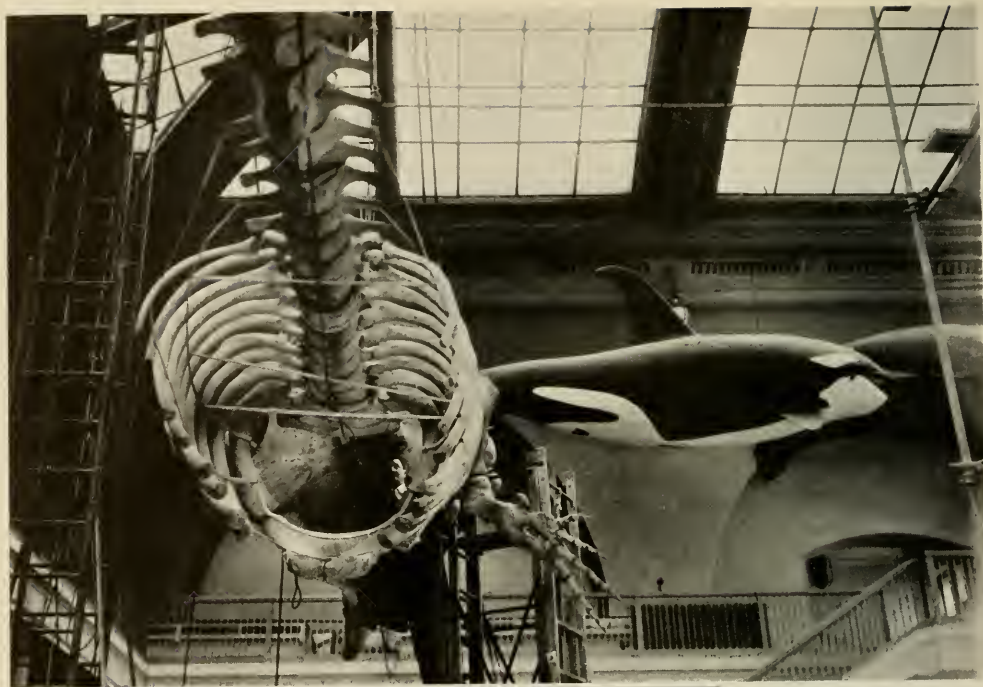
Clover, who captured them at Guadaloupe Island. The director of the Zoo, Dr. H. M. Wegeforth, knew of the long search carried on by Doctor Townsend. Consequently, when one of these fur seals died, the specimen was donated to Doctor Townsend and, in turn, by him to the American Museum. Aside from the romantic interest which attaches to the history of the Townsend fur seal, brought to the very brink of total disappearance by the fur hunters of the late Eighteen Hundreds, the animal has the added distinction of being a northern straggler from the southern hemisphere. It is not related to the Alaska fur seal which winters at sea as far south as California, but is of stock similar to the Galapagos fur seal and the fur seals of high southern



PORPOISE AT PLAY AT THE
SCHOONER'S BOW

It is a not uncommon sight to see porpoise or dolphin playing about the bow of a moving ship, where they may remain for many minutes

Drawing by F. L. Jaques



AT THE WESTERN
END OF THE HALL

Looking 'up from the main floor one can see into the capacious body cavity of the sperm whale, the size of which is indicated by comparison with the man on the ladder



AT THE SOUTHWEST
END OF THE BALCONY

Against an effective background of cloudy sky and wind-swept sea a school of dolphins are pursuing their active way. At the top of the arch is one of the gigantic shells designed under the direction of Mr. James L. Clark as a screen for the mural lighting

LOOKING NORTHWARD
ACROSS THE EASTERN
END OF THE BALCONY

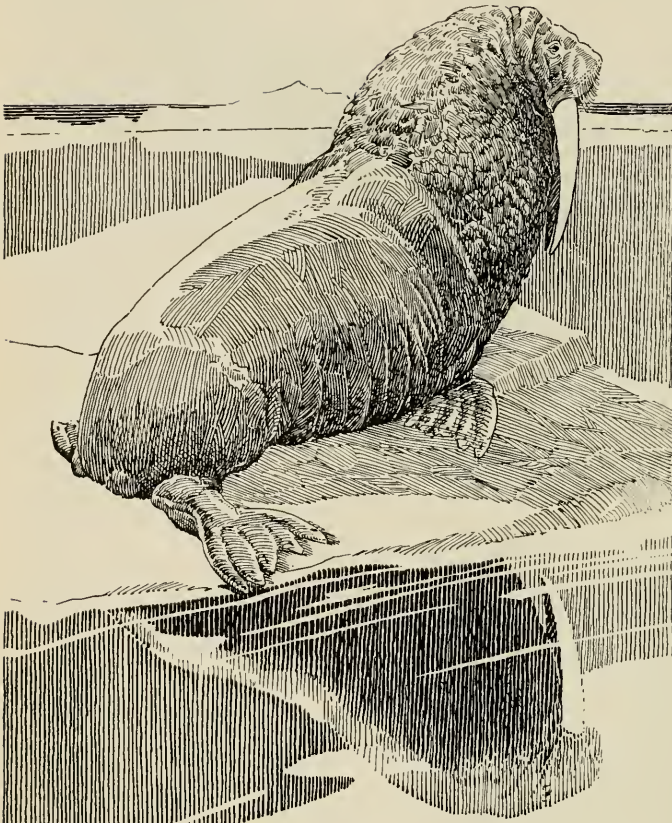
Overhead hangs a model of the giant squid, while just below it is the figure of the killer whale, the most savage and predatory of the cetaceans. The third large figure suspended from the ceiling is the blackfish, a species of giant porpoise. In the background are two of the Benson murals showing phases of American sperm whaling



THE SOUTHWEST
CORNER

This mural is a companion to the other study of leaping dolphins and balances it at the western end





BULL WALRUS ON THE ICE

For this sketch F. L. Jaques has drawn upon the studies he made while a member of the expedition which collected the large group of walrus for this hall. The walrus is a ponderous, clumsy beast when on the ice, but once he has clambered or fallen into the water, he is transformed into a powerful and comparatively graceful swimmer.

latitudes. The mounted specimen of the Townsend fur seal stands in a floor case in the center of the Hall of Ocean Life.

As a companion group to the elephant seal and, like it, with two openings from which the exhibit may be viewed—a large front glass and a smaller end window—stands the group showing the Steller sea lions at home on St. George Island in Bering Sea. These fine, big, sea mammals were placed in a Pribilof Island setting, under the direction of Dr. F. A. Lucas, who knew intimately the Pribilofs and their seal life. Unlike the elephant seals, the sea lions are very active (for seals) and

lose no time scrambling from the rocks into the sea when man approaches. The full-grown males are great, powerful animals, and are the most impressive of the true seals. Clumsy as the sea lions may seem as they propel themselves over the rocks, in the water they are the embodiment of supple grace and show a mastery of that element surpassed among their kind only by the fur seals. The trained seal of the circus is usually the California sea lion, a very near relative of the Steller, and both species are alike in possessing alert, intelligent faces and an uncanny sense of equilibrium.

The group of the Alaska fur seal is adjacent to that of the sea lions and, like it, has a Pribilof background, Kitovi Rookery, St. Paul's Island. Many of the out-

standing facts of the life history of this interesting species are well known to the general public to whom the animal means something more than a fur coat. The group shows a big bull with his harem of sleek, slender cows, and with the playful pups grouped about among the rocks. For a period of weeks these bulls remain on land, taking no food whatsoever and constantly on guard to prevent some less fortunate bull from stealing the harem. The cows come and go, and all around the island one sees their active forms cleaving the water. The female Alaska fur seal is one of the most beautiful and attractive of all the marine mammals, and

is often so fearless that it comes very close to a ship or boat. From the deck of the schooner "Morrissey," in 1928, in the Gulf of Alaska, I noted some so curious that they acted as if they might actually be coaxed aboard, following in the wake, with large, limpid eyes intelligently taking in any activity on the deck. Often they came toward the schooner, bounding clear out of the water like a dolphin in full career, and seeming to express a joyful hope that the steamer might care to play with them.

The group of Pacific walrus in the major space on the south side of the hall is not yet ready for exhibition. The specimens are all mounted, and when the painted background has been completed, the screen now before this space can be removed. At present a small-scale model shows how the finished group will look. The background depicts an ice field in Bering Straits, with East Cape, Siberia, in

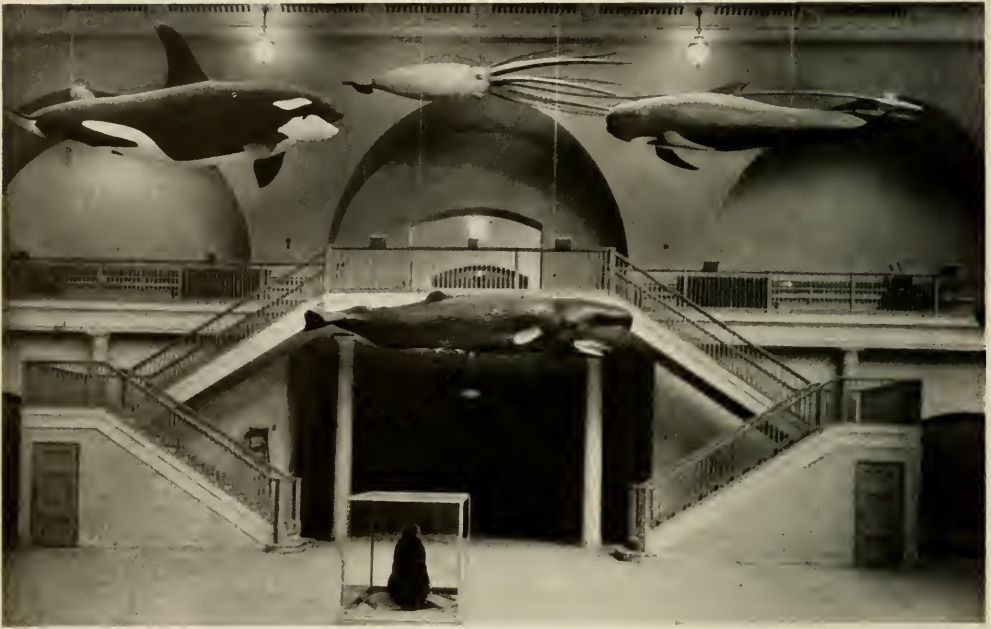
the distance. The walrus in the group were collected for the Museum by the Stoll-McCracken Expedition, which was financed by Mr. Charles H. Stoll. Studies for the background were made by Mr. Jaques, who accompanied the expedition in order to obtain first-hand impressions. I was in charge of the scientific work of that expedition, and during the sojourn in Bering Sea and the Arctic Ocean was able to make a number of observations on walrus, seals, and cetaceans, which have since been very useful in planning for the Hall of Ocean Life. The party went through numerous vicissitudes, including a broken propeller shaft in Bering Sea, storms in the Arctic Ocean, and a threatened ice blockade of Bering Straits before Mr. and Mrs. Stoll brought the quest for a group to a successful conclusion by shooting two large bull walrus in the region shown by the painting.

The Pacific walrus differs only in size



ANOTHER VIEW OF THE SEA LION ROOKERY ON ST. GEORGE ISLAND

As with the fur seals, the male sea lions are much larger than the females and the old bulls loom up conspicuously in the herd



THE EASTERN END OF THE HALL AS SEEN FROM THE MAIN FLOOR

Below the triumvirate of giant squid, killer whale, and blackfish hangs a cast of a baby sperm whale. In the floor case is a specimen of Townsend's fur seal

and divergence of tusks from the Atlantic walrus, but was chosen for the group because it is noticeably a more impressive animal. One of the bulls to be shown in this group is carrying an unusually fine pair of tusks. Walrus tusks, before the advent of the white man, furnished the Eskimo with a hard, durable material for most of his simple tools and implements. Even today the ivory is still eagerly sought, but economically the animal is more important to the native as an abundant source of meat. We were told some things, interesting if true, concerning this stiff-whiskered denizen of the sea. It seems that walrus enjoy the summer sunshine and like to crawl out on the ice to lie there for hours at a stretch. When the weather is bad and strong winds rock the ice pans, the animals, not being comfortable "rocked in the cradle of the deep," are driven off into the water, where they cruise about awaiting a calmer day. After a long spell of such forced immersion, they are eager to come out for

a good, long sleep. But like some of us who are tempted to lie too long on a sunny beach, the walrus overdo the matter and become sunburned. Whereupon, they dread the shock of the cold water upon their skins and are reluctant to plunge into the sea again. At such a time the hunter is able to kill a considerable number of them upon the ice before they seek safety in the water. To look upon walrus hide, one would not imagine the beast could be susceptible to sun burn, but why cast doubts upon a good story!

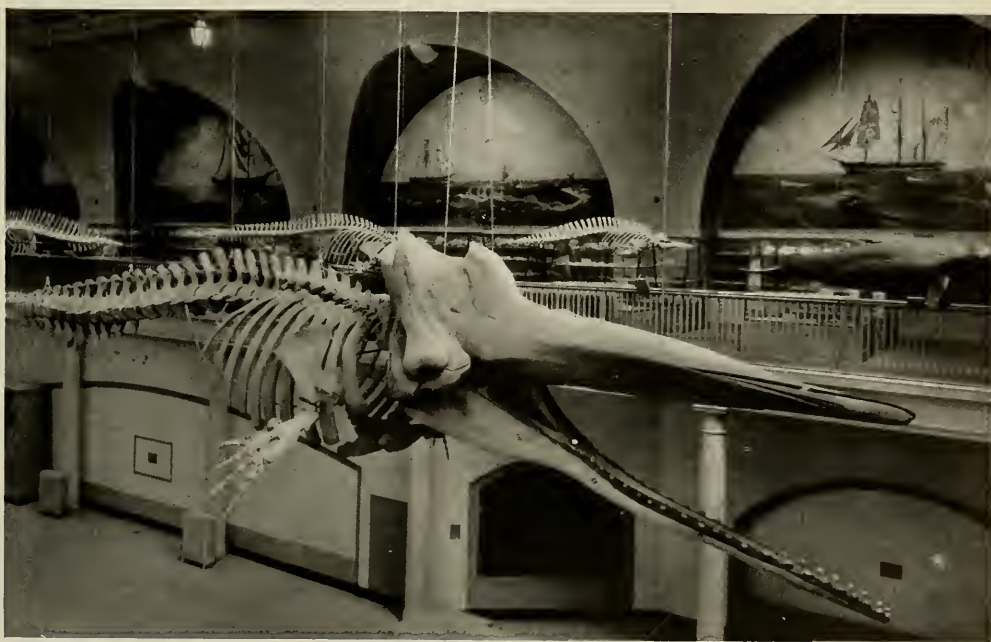
The Eskimo told us of going on hunts for the walrus, a party of them following these big animals in their skin boats or oomiaks. Sometimes the killer whales follow up the bands of walrus, too, and there is no competition between the killers and the Eskimo. The latter go back to their village and leave the field to the big porpoise, for an oomiak is a fragile thing and the Eskimos are not swimmers. If an oomiak is damaged and doomed to sink, I was told that the head man passes

from one to the other of the crew, cutting their throats, and then cuts his own. It is easily understood why the natives do not look forward to any encounter with the savage killer whale, and also why the traditions of attacks by killers are usually hearsay. There are no eye witnesses who survive!

On the north side of the hall is a habitat group of the Florida manatee. This grotesque species inhabits the warm, shallow waters along both coasts of Florida, and frequently works well up into estuaries and lagoons. There is very little about the appearance of the manatee to suggest beauty or allure, yet the group to which this animal belongs is known as the *Sirenia* (siren-creatures). It is said that some of the earlier accounts of mermaids were inspired by a glimpse of a mother sirenian with a baby clasped to her breast, but certainly the sirenians of today are no inducement for a sailor to

leave home. One of the chronicles of early discovery, *De Orbe Novo of Peter Martyr*, tells of a tame manatee which came when called to be fed or even to carry its master over the lake. Of more prosaic interest, but possibly sounder life history, are the facts that the manatees graze upon marine grasses on the sea floor, are harmless, sluggish creatures, are susceptible to the occasional cold snaps of those rare winters when even native Floridians admit they have had a frost, and may be killed outright, and finally are good to eat.

The unfilled habitat spaces on either side of the hall will eventually be occupied by a number of interesting groups. Among these might be mentioned a group of hooded seals and harp seals, a group of sea otter, a group of hair or harbor seals, and a large group of dolphins or porpoises in action under water.



LOOKING TOWARD THE NORTH WALL FROM THE BALCONY

The skeleton of the large sperm whale shows the great jaws and peglike teeth of the creature. The sperm whale is the only whale which could have met the specifications required by Jonah for his ocean voyage, since this is the only cetacean capable of swallowing a man entire. The other large whales have comparatively small throats, for they feed on great numbers of lesser animals, but the sperm whale seeks larger prey which it swallows either whole or in great chunks

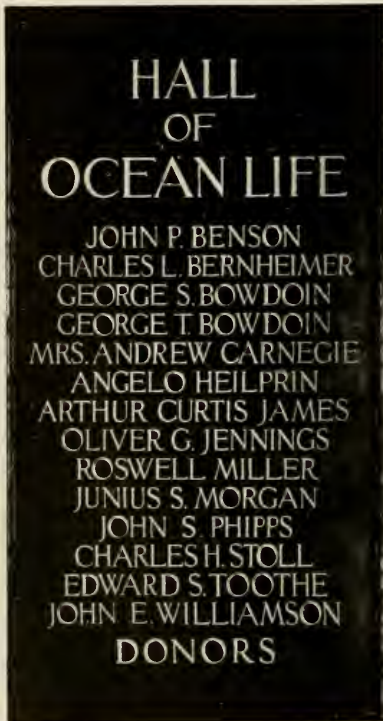


MODEL OF THE PACIFIC WALRUS GROUP

Until the group itself is completed this small-scale model will be on display in the space to be devoted to the group

Among the important additions which in time will appear in this hall is a full-sized model of a diving humpback whale. This will be a most striking exhibit, for the humpback with his great knobbed flippers and contrasted black and white markings, displays more character than the other whales, and is cast by Nature for the star rôle in a hall of ocean life. There are several other features which are needed for the hall, but which call for the appearance

of a fairy godmother to supply the necessary funds and luck. These are a skeleton and field measurements of a really large blue whale (they have been taken in the Antarctic 109 feet in length), and a skeleton and measurements of a large bow-head whale, a species all but extinct. The accession of this material would equip the Museum with the means of exploiting to the fullest the great possibilities of the Hall of Ocean Life.





THE SOUND MIRROR, MOUNTED ON A TRIPOD, IS BEING FOCUSED ON A PROSPECT

HUNTING WITH A SOUND CAMERA

How Bird Songs Were First Captured in the Woods
and Transferred to Phonograph Disks

BY ALBERT R. BRAND

Associate in Ornithology, American Museum

NO doubt many ornithologists have thought of the possibilities of recording the sounds of wild birds, but it was not until a few years ago that science had advanced sufficiently to make it possible for one to go out into the woods and actually photograph the sounds. Every amateur bird student knows that he cannot expect to identify birds unless he can recognize their songs and calls; and while identification is only the beginning of the study, it is the means to further and more serious work; for no one who would aspire to ornithological knowledge can be without at least a working acquaintance with his local birds. In the past, making this first hurdle has been the obstacle; it was very difficult to acquire this fundamental essential, a knowledge of bird song.

Not so many years ago, when I was starting my bird studies, I consulted several prominent ornithologists, and put my problems before them.

"I can learn what the bird looks like," I explained. "I can get all the good pictures of birds that I want; there are many sets of excellent color plates of our native song birds; but where can I get a set of phonograph records of bird songs?"

The answer was invariably the same: "There are none; and there is only one way to learn bird sound. Be constantly in the field, early and late, as often as possible, especially during the song season. Chase up each individual songster whose voice you do not recognize. After years of this study you will gradually learn."

There are, it is true, in most bird guides and handbooks, attempts at interpretation through the written word, but these are almost useless, and especially to the beginner. Several authors have even tried to put the bird songs on the musical scale, so that they could be played on the piano and the violin. This seems to be a logical method, but in practice it does not work out. Many birds do not sing in the



Photograph by P. Paul Kellogg

"ON LOCATION"

The sound truck ready for recording

cal friends were correct. Either I would have to prepare to be out-doors every spare moment, or I had better give up the idea entirely, and seek some less confining avocation.

Many a would-be bird student has been thus stumped. He had the desire, the patience, and

man-made scale; their notes are often not whole or half tones, but may be quarter tones or other fractions that cannot be accurately represented. Other birds such as the flicker and blue jay make sounds which simply cannot be translated in musical notations.

Beside this there was practically nothing except a very few phonograph records of bird men whistling imitations of bird sounds. These are at best unsatisfactory. While there are a number of imitators who are very clever, and who can imitate some birds quite accurately, they are always limited. There are a few songs that they can deliver faithfully, but beyond that it is only by a wide stretch of the imagination that one can even sense the similarity between the imitation and the genuine.

There was no doubt but that my ornithologi-

the willingness and ability to work, that is necessary to become a proficient bird student, but he did not have the time to devote hours and hours, and days and days to intensive field work. In bird study, as in the other natural sciences, field work is essential,— it is not only essential, it is one of the most enjoyable features of the study. Now, with records available, the time required in the field will be greatly shortened, and this should mean that many students who heretofore had to give up for lack of time can join in this ever fascinating pursuit.

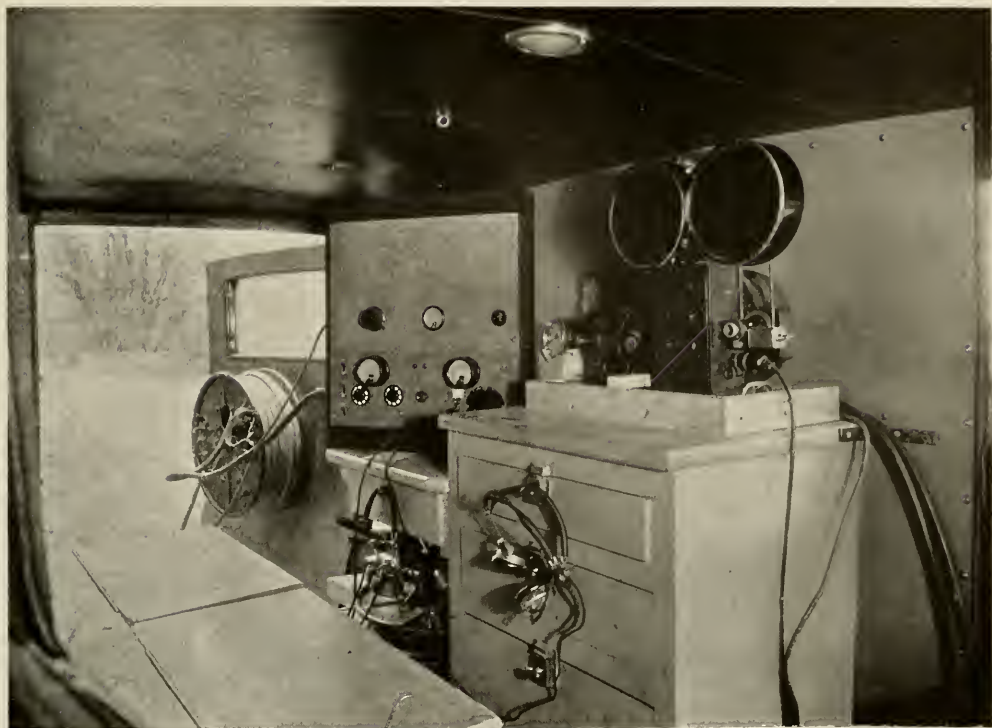
No serious effort to record bird songs except by writing them down on paper had



THE ELECTRIC EAR

The microphone is centered directly in the beam of the parabola or sound mirror. This increases the efficiency about twenty-five times, and eliminates disagreeable background noises

Photograph by M. Peter Keane



Photograph by Troy Studios

THE INTERIOR OF THE SOUND TRUCK

Showing the wheel of cable on the back door, the amplifier switchboard and control, and (right) the sound camera, on which is mounted a magazine of film

ever gone beyond the embryonic stage. Recording bird songs by the method which I use, required, first, the perfection of the radio amplification tube; and second, the technique developed in the making of sound motion pictures. The commercial perfection of the radio tube is very new indeed. All of us can remember when there was no radio. The "talkie" is even newer. It is hardly five years since Al Jolson as the "Singing Fool" made his debut on Broadway.

I have often been asked, when showing my sound truck and its rather complicated looking apparatus, "Did you invent this machine?" I hasten to answer that I did not. Five years ago I knew nothing about electricity and mechanics. I do not know so much more now; but I did know that if it is possible for the moving picture industry to go out into

the open, and take sounds of current events, it is just as possible for the naturalist to do the same thing, and record the songs of wild birds. Just as many people who know nothing whatever about the inside of an automobile are excellent drivers, so a person without any special mechanical gifts or training can learn to operate a sound-recording apparatus, even if it does appear to be a rather complicated and awe-inspiring piece of mechanism.

While my machine was in process of construction I often had the feeling that mine was a case of "fools rush in where angels fear to tread." And the results, when the machine was first completed, seemed to justify that thought. I shall not bore the reader with all the trials and tribulations of the first experiments with our sound recorder. Suffice it to say that



THE GREAT HORNED OWL

From a motion picture taken by Arthur A. Allen. (Right.) Photograph of the hoot of the great horned owl. The small cross lines on the sound track on the right side of the film are the photographic impressions of the owl's voice. As the hoot is of low frequency the lines are fairly far apart

the machine which we finally constructed could hardly be recognized as the one that had been originally planned. Instead of being portable, it was housed in a small Ford delivery wagon. In essence it was the sound-recording half of a location or newsreel motion picture recorder.

We had been experimenting for months, and my audio-engineer had brought the machine up to Cornell University where I was studying. He felt sure the machine could do what we wanted, and it was a great disappointment when he had to take it back to New York City for complete overhauling and reconstruction. In answer to his telegram that everything was shipshape, I took a trip to the city and was forced to hang around in machine shop and laboratory for days and days, while this little part was being perfected and that seemingly unimportant detail made right. I took him and his assistant to my own stamping grounds north of my home in White Plains. The location was a swampy pond on a back road. It was an especially "birdy" spot. We left the city before dawn, and recorded several hundred feet of film. There were song sparrows singing, and we hoped we had caught their roundelay. This would be an excellent test. We rushed the film to the development laboratory, and before evening heard the results. There was nary a suggestion of



a song sparrow's song,—just a chorus of spring peepers and bullfrogs,—none too faithful at that,—and the occasional barking of a farm dog, the crowing of a cock, and the warning whistle of a railroad train as it approached a crossing in a valley some miles away. This latter was perhaps the most realistic of all our records to date.

I left the machine and went back to my studies at Cornell, while Mr. Hungerford, the audio-engineer, swore he would not return to Ithaca with the machine until he had made at least one satisfactory recording. That time arrived at last, and it was a memorable day in the lives of the experimenters. He had recorded

at the swamp north of White Plains where we had made our first disheartening test, and had brought back with him the machine and a developed roll of four hundred feet of film. There were bird sounds on it, that he assured us, though he did not know exactly what they were. "No, there was no song sparrow; but there was a funny little duck that bobbed up every now and then, and made a hell of a racket! We got some of that." I quote his words as nearly as I can remember.

Through the courtesy of the local moving picture theater, we had an audition of our sound after the even-
ing performance. Prof. A. A. Allen, head of the department of



MEADOW LARK ON HIS SINGING PERCH

From a motion picture taken by Arthur A. Allen. (Left.) The picture of the meadow lark's song. There are horizontal lines crossing the sound track but they are so close together that they are almost invisible to the naked eye. Compare with the record of the hoot of the great horned owl



ornithology at Cornell University, and a group of interested bird students were there to hear the first bird sound recorded. Bird sound it certainly was, and though it was not perfect,—the ground noises, as the engineers call the constant out-of-door sounds, were quite apparent,—the recording was so good that it has since been used many times, and has been transferred to phonograph records and sound motion pictures. I call the phonograph record "A Spring Morning in the Swamp." Blue jays, woodpeckers drumming, and the "honk-ker-ree" of the red-winged blackbird are faithfully recorded, and the "funny little duck that made a hell of a racket" turned out to be no other than the pied-billed grebe or hell-diver. His song had been very aptly described. Had the experimenters gone out for no other purpose than to record this sound, they could not have set the microphone in a better location to catch

the sonorous, long drawn-out "cows" of this, the smallest of our grebes.

From that day in April, 1931, we have been recording bird sounds successfully. We have met many snags, have had many failures, have made improvements here and additions there; but the pioneering was over. We now knew we could accomplish our aim. It is only a matter of time until we shall have recorded all the songs of our commoner wild birds. That time is still in the future, but we have taken about half of them now, and we face the task of getting the remainder with a confidence that should bring success.

In order to understand what we were trying to accomplish, let us follow the sound vibrations as they are emitted by the bird in the field, and caught by the microphone, until they are finally placed on phonograph records. We shall trace the path of the sound from the songster's throat as he sings on his favorite perch



Photograph by Arthur A. Allen

THE PIED-BILLED GREBE

The "funny little duck that hobbled up every now and then, and made a hell of a racket!"



THE PIED-BILLED GREBE'S NESTING GROUNDS

Forest Lake, near White Plains, New York, where the first successful bird sound recording was made

near his nest, sending his challenge to the rest of his kind; through the process of recording, until it is again emitted, this time through the loud speaker of our phonograph, instead of from the bird's throat. The out-doors will have been transferred to our living room and we shall then be able to study bird song in the shelter of our own home.

The microphone has been placed in the woods not far from the singing perch of a bird. When the bird sings he sends forth mechanical vibrations, (sound). The microphone catches these, and transforms them to corresponding electrical vibrations. They are extremely minute, however, and must be greatly magnified before they can be used. The mechanical ear or microphone is designed to receive and amplify these minute vibrations. The transformed electrical vibrations then travel through the cable to the main amplifier in the truck. This piece of

apparatus has a familiar appearance for it looks and is very similar to an ordinary radio. (A radio set is, of course, at least in part an amplifier). The vibrations are again greatly magnified until finally they are large enough to be transformed into sound, and to be heard through a pair of ear-phones. The person operating the sound camera in the truck wears these, and he can hear what is going on outside in the woods; a fly or a mosquito that may chance to be near the microphone can be distinctly heard more than two hundred feet away. I recall one early morning having the microphone set up in the woods. I was in the car, with the ear-phones on, listening in, and all the doors and windows of the truck were tightly closed. The mosquitoes were very thick that morning, and in the ear-phones I could distinctly hear their buzzing two hundred feet away. Not once but at least four times during the recording I



"OH, LISTEN TO THE MOCKING BIRD"

The dynamic microphone is set up on a post 250 feet from the truck in an attempt to capture the mocking bird's song

found myself raising my hand and slapping at the back of my neck. This is my usual defense reaction to what I had been hearing. And all the time I knew that there were no mosquitoes in the truck.

But to get back to our sound wave, which now has been greatly magnified, and is ready to have its picture taken. From the amplifier it is conducted to a glowlamp. This appears to be an elongated electric light bulb about an inch thick and eight inches long. We are now at the heart of the machine. It is here that the vibrations are converted into light. If you were to hold this bulb in your hand when the switches were turned on you would see at the end of it a peculiar

ball of purplish light. This light would not be of constant brilliancy, but would flicker: one instant it would be most intense, the next, almost gone out; and these flickerings would be continuous and extremely varied. What is happening is that you are watching sound. Noises outside, near the microphone, are transmitted to the end of the glowlamp, and the various vibrations that have been set up by the sound, register as flickering light. It is these flickerings that are to be photographed. The glowlamp is now fitted in a metal tube which leads into the light-tight compartment of the sound camera. There is a slit .001 of an inch wide, through which the light is allowed to shine. This slit corresponds to the lens in an ordinary

camera. The sound camera, in appearance, is quite like an ordinary motion-picture camera. There is a magazine on top of it which has two compartments. The first of these carries the unexposed film, the second the exposed but undeveloped picture of the sound. When the motor switch is thrown, the unexposed film is carried into the camera. On its way to the second compartment it travels directly in front of the light slit. The glowlamp is on the outside of the slit, the fast moving film, on the inside. As the film passes the slit, the flickerings of the glowlamp are registered on its sensitized surface. Each second eighteen inches of film passes this slit in front of the flicker-

ing glowlamp. Thus the many flickerings representing sound vibrations of various frequency, are faithfully photographed.

From this point the process is identical with motion-picture taking. The film is developed, and prints are made from the negative. It is then played on the same machine that is used in all motion-picture houses.

A late development in our recording was the addition of a sound mirror, or parabolic reflector, to our equipment. This made it possible to record birds at much greater distances than heretofore. The sound mirror is a large, circular contraption, the shape of a section of a parabola. The microphone is pointed toward the center of this disk and in the opposite direction from the bird. With the use of this apparatus the sound is magnified more than twenty times before it enters the microphone. The reflector, with microphone attached, is set on a tripod. There is a sighting device,—similar to a gunsight,—which is focused on the bird. The outstanding feature is that the mirror will reflect only sounds that are in its focus. The song of the bird, when properly focused, will be magnified twenty or twenty-five times, while all other sounds will remain as they were. Thus in effect the outside noises are very nearly shut out, while the sounds wanted are greatly increased. With this device we did some long distance recording. Perhaps our longest shot of any of the

common small song birds was one of the orchard oriole. The truck was 250 feet from the microphone, and the microphone was at least another 100 yards from the bird, when this was taken, and it was very difficult to distinguish the bird through the gunsight; yet the resulting sound-picture was very satisfactory.

In order that the reader may better understand how these recordings are made, I am going to ask him to accompany me on an imaginary typical early morning recording. Birds are in full song for a comparatively short period of the year; and so most of our recording has to be done from mid-April to mid-July. About three-thirty of a fine, cool morning in



Photograph by M. Peter Keane

PREPARING FOR THE SET-UP

The condenser microphone, mounted on a tripod, is being taken out into the woods

May our little truck rolls up before your door. You thought it rather strange when I suggested that you wear a sheep-skin coat, but now you realize that there was method in my madness. The sun is not yet up but the sky is aglow with the glories of the coming day. The only sound is the morning chirp of an awaking song sparrow, or the occasional note of the early robin, as he arouses himself to start his search for the proverbial worm. As we drive through the dew-laden countryside toward the high woodland that is our destination, we pass a farmyard and hear old chanticleer give his familiar refrain. This crowing of the rooster, pleasant as it sounds, is likely to become a great nuisance, for his lusty cry has ruined many of our otherwise fine recordings.

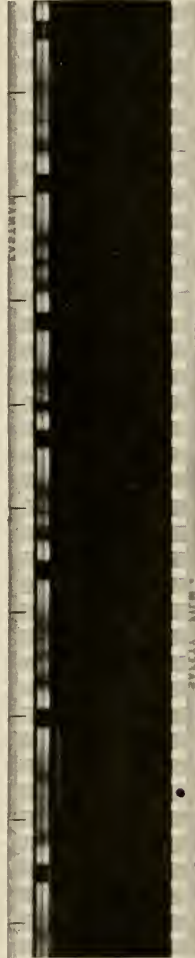
We have now arrived at our woodland destination. I had been out here the day before, and looked over the ground to find the most likely place to set our microphone. A northern water-thrush has just started his bubbling warble. He repeats it constantly and at frequent intervals. It is so loud as to be somewhat startling. We are indeed fortunate, for here is a song that should record easily, and in the quiet of the early morning there are few interfering sounds. I hop out, open the back door of the truck, and grab the end of the 250-foot roll of cable. This is wound on a metal wheel which is on the door, and unrolls as one walks out with it. I also sling a microphone, mounted on a tripod, over my shoulder. It is set up in short order, within twenty-five feet of the low alder where the bird is

singing; and very soon I am back in the truck, with the ear-phones on, listening in. There are a few little details to attend to in the truck. Tests to be made to be sure that the batteries are at the correct amperage and voltage; the minute slit through which the exposure is to be made, must be examined to see that no particle of dust is clogging it. The glowlamp must

be looked over, and then set in its place next to the slit. However, with luck, we are all ready in less than ten minutes. You, as my guest, sit next to me on the bench in the truck, opposite the camera. There is a spare set of ear-phones which you have on; you are amazed how clearly you can hear the singing outside.

I listen a minute or two, adjust several switches on the amplifier so as to get the desired amount of volume in the ear-phones; and at the right moment throw the motor switch which sends the film careening through the camera, merrily catching the gay gurglings of our ecstatic songster. The film is run for perhaps two minutes, and you have noticed that I have made several adjustments from time to time. These, I explain, are changes in amplification. We increase or decrease the volume that is fed to the glowlamp. Then, after the film is developed, we can pick out whichever song is the best. Not more than one tenth of the film will be used, however.

But do not think that sound recording is always as simple as it was this morning. We have indeed been fortunate. Often we have started out under similar circumstances, only to find that ten minutes after the sun



THE DRUM OF THE
RUFFED GROUSE TRANS-
FERRED FROM THE
WOODLAND SWAMP TO
PHOTOGRAPHIC FILM

has risen, the wind has done the same. Our long trip to the location has been futile. It is not even worth while to take out the microphone. For wind is our worst bugbear. I never realized the true meaning of the phrases, "the whispering willows," or "the murmuring pines" until I started sound recording. Even a moderate wind makes bird recording very difficult, if not impossible. A babbling brook, or the pounding of the waves on the shore, will force one to desert, even though the bird be a rare one, and the song his most beautiful offering. Then frogs, too, can make a great nuisance of themselves; we were very fortunate that they did not start their raucous calls this morning, for, if they had, we would never have obtained our recording. The rooster I have already mentioned; his companions of the barnyard, the calf and the farmer's dog, can make themselves equally obnoxious.

In fact, there were several occasions when we had located birds singing that we were particularly anxious to record. All went well in the setting up until our operations were discovered by a neighboring watch dog. He, however, expressed his disapproval in loud bursts of canine profanity. There was nothing to do except either to shoot the dog, or pull up stakes and find a quieter location! Suffice it to say we went elsewhere. The farm tractor, too, can be very annoying, or a train in a distant valley, or a cruising aeroplane will disturb the quiet of an otherwise excellent pastoral site. Too close proximity to a traffic road, or to electric wires, is fatal, so it can be easily seen that we had numerous obstacles other than the temperament of the birds themselves to hinder us.

And the birds! They were not always as good subjects as our water-thrush. Time and again we would set up while a bird was in full song, only to have him scared off by our maneuvers. Of course



THE RUFFED GROUSE

On the drumming log. From a motion picture film by Arthur A. Allen. Recording this bird's mating call was a stumbling block, but after spending four nights in the woods the sound recorders were rewarded. The bird drums most consistently at the inconvenient hour of 3:30 A.M.

*Photograph by Troy Studios*

LISTENING IN

The sound apparatus in action. With ear phones on, the operator in the truck watches the monitor board to see that the bird song is recorded properly

this is to be expected, and not nearly so aggravating as other incidents; for instance, early one morning we set up on a catbird that was singing beautifully. Everything went smoothly during the set up; it made my heart glad to hear his varied gurglings and splutterings, interspersed occasionally by his more catlike mew. But just as we had turned all the switches on, he stopped. The bird-lice were bothering him. He ceased singing and devoted himself to a search for the elusive insects. Thinking he would soon get tired and resume his song, we let the machine run on. But no, he kept up the "de-fleaing" process for a full two minutes. Meanwhile our expensive film was placidly running through the camera at the rate of a foot and a half a second.

Finally I shut off the machine. This seemed to be the bird's cue, for he immediately started to sing again. He kept it up until we, thinking he was now certainly

going to continue, threw the switches a second time. How he got our signal I cannot say, but before we had recorded a single chirp, the perverse bird stopped, and started to dig and scratch once more. He was a most contrary bird, and if the truth must be known, we never did record that particular cat-bird!

But the recording has now been made; the job is, however, only well begun. After developing the film, it must be played back, and later very carefully edited. Playing back film can well be described as the reverse process of recording. The film is run through a machine known as a projector. This is the same machine that is used in the motion-picture houses to display sound movies.

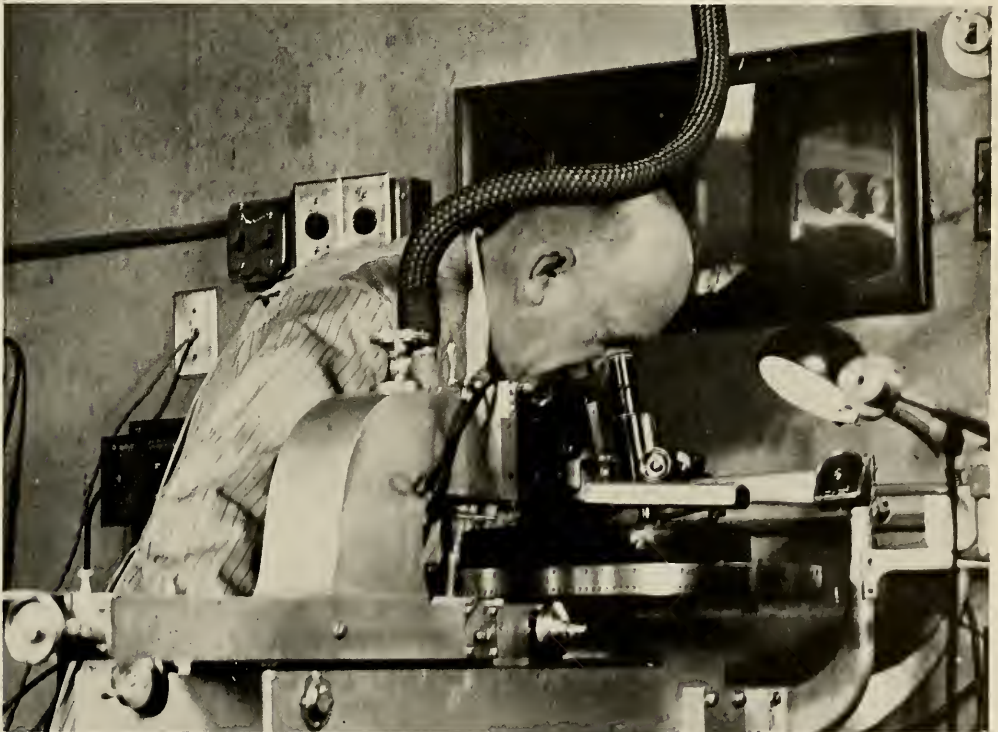
Let us see how this reverse process works. Out in the field we were trying to get a picture of the sounds we were hearing; now we are trying to take the developed picture and reconvert it into

sound. The film running in a projector, passes in front of a fine slit, exactly as it did in sound photography; but instead of there being a glowlamp to make the exposure, there is a photo-electric cell to pick up the photographed sound vibrations. A brilliantly focused light shines on one side of the track through the fine slit, and into the photo-electric cell on the other side. As the film passes the slit, the lines on the track,—the photograph of the sound,—are made to shine on the photo-electric cell, and the visible vibrations are reconverted into electrical energy. As in the recording process, this energy is amplified until finally it is great enough to be fed to a loud speaker which converts it from electrical energy into sound.

Editing is a never ending task, for it is almost impossible to determine exactly where song is on the film, and it would not

do to cut a bird's song in half, for instance. The safest method is the slow and tedious one of playing the film back until by ear you have marked the best cuttings. Ordinary low frequency sounds such as the human voice or orchestral music are easily seen on the film, but not so with many of the extremely high bird notes. For the higher pitched the sound the closer together are the lines on the sound track. and the song of the yellow warbler, for example, appears on film as a great many very thin hair lines, so fine as to be hardly visible to the naked eye. They can best be seen under a magnifying glass in a strong light. Fortunate we are indeed that the photo-electric cell, that man-made "sound eye," has better than human vision, for, had it not, we never would be able to reproduce the sounds of wild birds.

Most of our film, for one reason or another, is not good enough to use for



IN THE RECORDING ROOM

Transferring the sound on film to a wax disk from which the phonograph records are eventually made

record-making. If one tenth of what we have taken is usable we shall be well satisfied. But it is that tenth with which we are concerned. This is finally cut from the original film, and spliced. We are now ready to change our field of operation to the recording room of a phonograph-recording laboratory. Here the edited film is played through a sound recorder, and the electrically transformed sound, instead of being fed into a loud speaker, as heretofore, is fed into a record

cutter. The first record is made on a wax disk, and after various processes which it will not be necessary to describe here, but which are standard for making all phonograph records, a finished record appears, and we have at last reached our goal.

At the break of day, in the wild bird's home, we have caught his song. We can now reproduce it with all its original trills and cadences, at our leisure, in the confines of our own living room.



Photograph by Arthur A. Allen
THE RUFFED GROUSE PROUDLY DISPLAYS HIS RUFF AND SPREAD TAIL,
TO THE INTIMIDATED FEMALE



©Jim Thompson Co.

Mt. Le Conte from Gatlinburg, Tennessee

TWO THOUSAND MILES ALONG THE CREST OF THE ATLANTIC HIGHLANDS

The Appalachian Trail Which, When Fully Developed, Will Form a
Continuous Woodland Path from Maine to Georgia

BY WILLIAM H. CARR

Assistant Curator, Department of Education, American Museum

The Appalachian Trail is a path on the crestline of the Appalachians, stretching from Maine to Georgia: its projected length from Mt. Katahdin to Mt. Oglethorpe is estimated at 2054 miles, of which 1728 are completed. The plan of the "AT" was originated in 1921 by Mr. Benton MacKaye, and in 1925 the Appalachian Trail Conference was formed, consisting of a federation of the local clubs. An executive committee of eighteen persons, headed by Mr. Myron H. Avery, now has the work in charge.

—THE EDITORS.

THE imagination of all who are interested in the out-of-doors will be fired by a far-reaching plan that concerns a large portion of the Eastern American landscape. The Appalachian Trail that runs along the crest of our Atlantic highlands for more than 2000 miles represents this tremendous plan that is nearing physical completion. Its objective is to restore and make available to the people at least a portion of the Eastern primeval region that should be their heritage. It is a slender brown thread binding together the wilderness areas from Maine to Georgia.

Thousands of hikers have walked along various sections of this long trail. Increasing numbers will grasp the opportunity to follow its ways as the years go on. Many separate groups, from one end of the footpath to the other, act as volunteer woodsmen by clearing the way, building shelters, and providing generally for maintenance. These groups are organized and function as integral parts of the "Appalachian Trail Conference." The influence of their accomplishments will linger as long as there are people who seek the open for rest, recreation, and cultural pursuits.

In "The Appalachian Trail—A Guide to the Study of Nature," published in *The Scientific Monthly*, April, 1932, Mr. Benton MacKaye, the originator of the Appalachian Trail project, reminds us that "primeval influence is the opposite of machine influence. It is the antidote for over-rapid mechanization. It is getting feet on the ground with eyes toward the sky—not eyes on the ground with feet on a lever. It is the thing whence first we came and toward which we ultimately live." Now, however, that the completion of the physical Trail is at hand, Mr. MacKaye looks ahead. He envisions other and greater uses for the "AT" than merely serving in a hiking capacity. He and the members of the organization regard the entire project as a comprehensive, rational, and highly useful "guide to the study of nature." This is exactly as it should be! Herein are we vitally interested.

Our mind's eye immediately travels over the length and breadth of all the Eastern section. We see the forests of Maine, with masterful Katahdin standing against the horizon. We travel southward to Mt. Washington in New Hampshire, down through the New England States to the Highlands of the Hudson where the Trail dips sharply over Anthony's Nose, crosses Bear Mountain Bridge, and continues up Bear Mountain, through the Palisades Interstate Park and on through the Blue Ridge region, across the Great Smoky Mountain National Park, coming to an end finally upon Georgia's Mt. Oglethorpe.

Millions of people live in the States through which this woodland path winds its way. The thought of the ultimate possibilities of this Appalachian Trail to inspire dwellers near by, almost overwhelms one! What better opportunity could there possibly be to acquaint



Photograph by H. J. Newton

MIANUS RIVER, NEAR GREENWICH, CONNECTICUT

Winding rivers with rocky beds tell stories of various stages of stream erosion, familiar knowledge to "AT" walkers

citizens with the world in which they live! It is not essential to wander far afield to see the wonders of creation. As Whittier wrote:

He who wanders widest lifts
No more of beauty's jealous
veil
Than he who from his door-
way sees
The Miracle of flowers and
trees."

In these days of rapid transportation, the Appalachian Trail is at the "doorway" of half the population of the United States. Fortunately, it is strategically located. The masses will never trample upon its wayside flowers, nor rob its birds' nests. Only those who are sincere and in whom a love of the open has been inbred, will spend their leisure hours upon this woodland way.

The time has come to encourage those for whom the Trail is intended, to grasp added facilities for applied appreciation as they journey along. The American Museum of Natural History has pioneered in the field of outdoor nature education. Since 1920 this institution has been actively engaged in this endeavor in the confines of the Palisades Interstate Park in New York State. Today a section of the Appalachian Trail is included upon the American Museum's Nature Trails. It runs directly past the open doorway of the Bear Mountain Trailside Museum. There have been many "AT" travelers along this route. We who operate this educational undertaking have had endless occasions to gain intimate knowledge of the expressed "requirements" of



Photograph by Clyde Fisher

BEAR LAKE, MAINE

Bold, rocky prominences are favorite "lookouts"

persons who visit us. There is ever a keen and intelligent desire on the part of these hikers to know more of the country through which they travel. For seven years we have tried to aid them in this direction.

We realize that many of our guests are concerned with the fundamental aspects of the landscape. They want to know something of the earth-making forces that have combined to create the present-day appearance of the land. Other individual hikers question us as to the animal life of the region. Many express a desire to know more of the surrounding plant world. There are other phases of nature that interest these people as well. Our function is to answer questions, to



Photograph by B. M. DeCou

UPPER BUCK HILL FALLS, PENNSYLVANIA
Great wealth of natural history lore awaits those who follow the trails

suggest others, and to exhibit, indoors and out, the story of Nature as it relates to our particular territory. We seek to interpret Nature in an humble straightforward way. Ours is a plan, then, of Nature exposition.

All of this work, and much more, could have a very real bearing upon the Appalachian Trail as a whole. As the "AT" develops and broadens its scope, the time will come when some definite step will be taken to provide information centers along the entire Trail. This, indeed, is the point of Benton MacKaye's article, previously mentioned, wherein he says:

To learn to read—first-hand—on the horizon and along the stream—the big outlines of the primeval drama; to take specifically the Appalachian country as the common school and playground; to weave together the threads containing the total story of this country (even as already we have woven the separate sections of our total footpath): this appears to be the logical second stage for the second decade of our enter-

prise. A pursuit, such as this, to become acquainted with our scenery, should be the next step in developing the Appalachian Trail.

The answer to the question "How may the hiking public be served," might well be answered by a consideration of the Bear Mountain Trailside Museum as a project and as an educational unit. What more logical development could be projected than the establishment of other similar undertakings at regular intervals along or near the entire Appalachian Trail? Numerous Trailside Museums in National Parks of the West have admirably served their purpose and have demonstrated, beyond question, their ability to bring nature to the people, as well as the people to nature. If the name "museum" offends in an out-of-door plan, adopt another one! If the term "Nature Trail" also is objectionable, by all means secure another title! When all is said and done, the Appalachian Trail



FERNS ON GREGORY BALD, TENNESSEE
The man at the left is literally surrounded by a sea of ferns

is a Nature Trail. Perhaps another name should be employed to describe any activity concerned with the interpreting of features along the way. This, however, is a mere detail when contrasted with the immense influence that such a project would eventually exert upon succeeding generations of Americans.

There are innumerable side trails and wood roads that cross the "AT" at intervals along the way. Many of these provide the principal approaches to the main path. It might be advisable to erect guide centers, just off the trail itself, upon one of the side paths, within several minutes' walk of the "AT". By this method townspeople who did not desire to hike along the extended trail but wished to visit the Guide Post, could do so without any danger of "overtrampling" the throughway.

The Out-of-Doors Museum of Natural History, whether large or small, has for its



Photograph by Clyde Fisher

HIKERS' CABIN

The Appalachian Mountain Club Cabin at the foot of Tuckerman's Ravine



© Jim Thompson Co.

ON THE MT. LE CONTE TRAIL

Lichens, mosses, and plant life in rich profusion greet the hiker at Rainbow Falls

main purpose the collection of information in a central spot where it may be had for the looking, or for the asking. Nature Trails serve the people in much the same way. Here, instead of specimens indoors, natural objects, such as trees, flowers, rocks, and ferns are labeled and otherwise described in place. Live animals, too, are illustrated along the Trail.

In brief, the object of a Nature Trail is to tell some of the nature story where it may very well be told—in the open, along the trails where people walk. The two projects working as a single entity form an almost ideal teaching combination and informational clearing house at the service of every hiker. The trails lead to the Museum and the Museum, in turn, encourages visitors to return to the trails.

In the early stages of development of Trailside guide units, a broad vision should direct the hands of the builders. The



© Jim Thompson Photograph

"THE SMOKIES"

A winter scene from the top of Mt. Le Conte. This magnificent range of mountains is now preserved in the Smoky Mountain National Park



**A FAMOUS EXAMPLE
OF WATER EROSION**

Private interests have fenced the Natural Bridge in Virginia in order to charge admission. Water, not private interest, created the "bridge"

Photograph by Joseph Mosenthal

THE OLD MAN
OF THE MOUNTAIN

Some day the bold "face"
upon this mountain top will
fall. Ten thousand and more
years may pass before the
event takes place, but the
action of "weathering" is
relentless

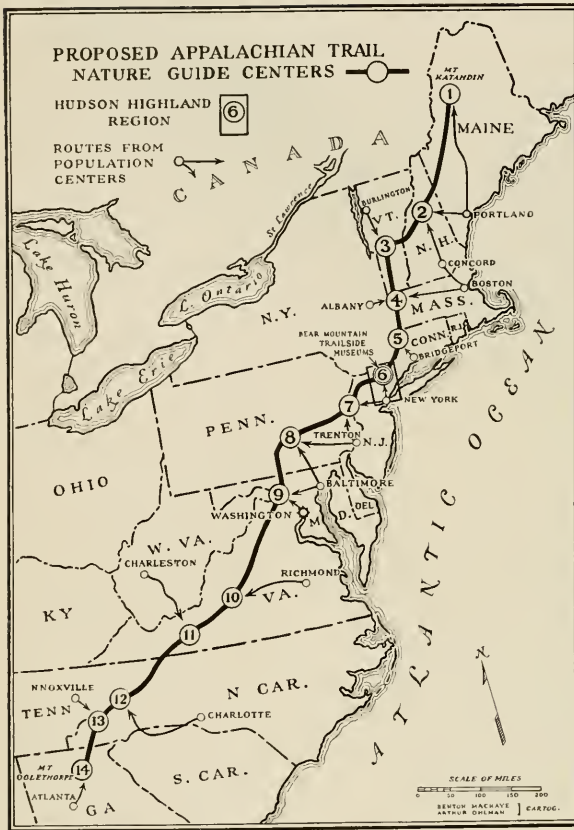


ROARING FORK CREEK

Another scene on the trail
to the top of Mt. Le Conte. It
has been said that every true
American *must* climb this
trail before he dies

© Jim Thompson Co.





FOURTEEN SUGGESTED TRAILSIDE UNITS

Nature guide centers, one in each of the fourteen states, connected by the "AT," are here proposed in the following regions: 1. Mt. Katahdin, Me. 2. White Mountains, N. H. 3. Green Mountains, Vt. 4. Berkshire Hills, Mass. 5. Litchfield Hills, Conn. 6. Hudson River at Bear Mountain, N. Y. 7. Delaware R., N. J. 8. Susquehanna R., Pa. 9. Potomac R., Md. 10. James R., Va. 11. Kanawha R., W. Va. 12. French Broad R., N. C. 13. Great Smoky Mts., Tenn. 14. Mt. Oglethorpe, Ga.

level should be interpreted in the simple but adequate language of clear-cut visual exposition, indoors and out. Identification of near-by objects, of individual minerals, plants, and animals, will come automatically, all in good time.

When the groundwork has been sketched, there will be the ever urgent occasion to indicate the present-day life of the region. Here evolutionary trends may enter in. Reminders of early days in the genesis of plants will be found and labelled. The great drama of forest succession must come in its place. An attempt should also be made to indicate

surrounding landscape should be considered as a whole and an attempt made to tell all-embracing stories of the form and development of the region in terms of earth-building forces. Rock-making should be described, geological successions traced, and the present-day appearance of the land explained through charts, diagrams, and relief models illustrating the underlying principles of the fascinating process of erosion. The all-inclusive panorama from mountain top to sea

INDIAN GAP TRAIL

In the distance are the "Chimney Tops." Many trails, other than the Appalachian, traverse this southern country

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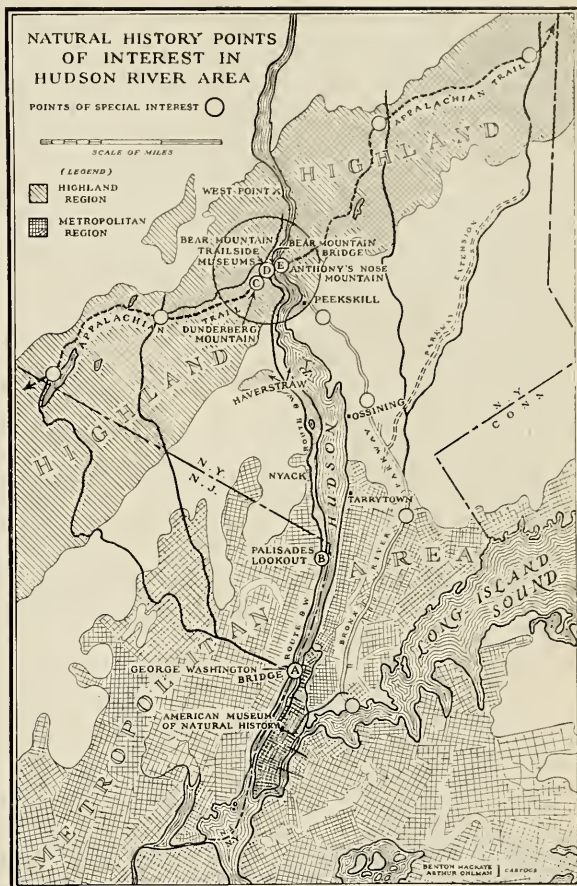


NEW YORK CITY TO BEAR MOUNTAIN

With the American Museum of Natural History as a starting point, the motorist may cross the George Washington Bridge, proceed up the west shore of the Hudson, and continue to Bear Mountain, where the Trailside Museum is located. From this point, crossing the Bear Mountain Bridge, one may return via the Bronx River Parkway to New York City.

past as well as present forms of the animal life found in the area. The entire exposition should be painted with bold strokes, with no suggestion of elaborate detail. It goes without saying that a policy of strict scientific honesty should be adhered to in every instance. There is no excuse for any other consideration. *Simplicity and accuracy*; these are the key-notes.

With the increase of leisure time due to unemployment and part-time employment, thousands of citizens are slowly but surely learning to take advantage of opportunities of free facilities for healthy recreation and instruction. To combine an intelligent out-of-door educational program with an equally intelligent plan



of recreation is another object of a Nature Trail and Trailside Museum undertaking. Walking has long been regarded as one of the most healthful exercises open to all. The Appalachian Trail admirably serves in this direction. The Nature Trail idea aids in the same way and offers a great deal more.

New York City is considered

TRAILSIDE AREA

The Bear Mountain Bridge, in the center of this area, and the Bear Mountain Inn, near by, are the landmarks of the region. The Nature Trail area extends between the bridge and the inn. Several new roads, including the George W. Perkins Memorial Highway, have been under construction since this map was originally drawn. This new road will run directly over the top of Bear Mountain and will afford an excellent view



Photograph by Clyde Fisher

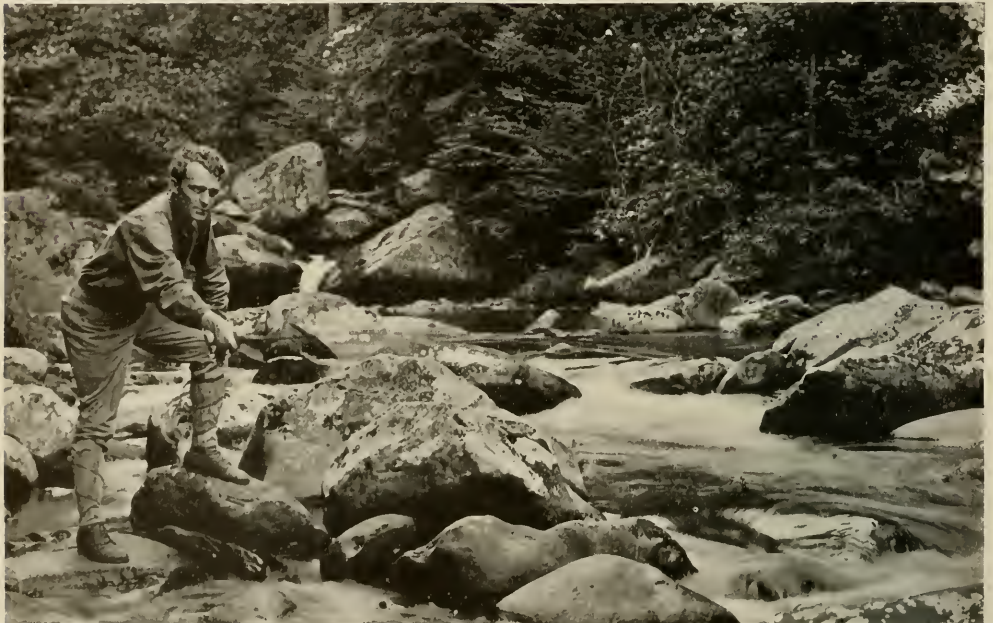
DWARF CANADA BALSAM

Near timber line of the Crawford Trail in the White Mountains of New England

the "center of population" of the United States. The Palisades Interstate Park, with its 47,000 acres of timbered lands, is

but forty-five miles away from this center. The Bear Mountain Trailside Museum unit established in this Park serves the people who visit the Park seeking release from a city environment. The maps accompanying this article offer suggestions for others who would build a similar project equally near some large city or cities.

Motorists might well be provided with road maps, giving directions as to how the Museum area might be reached. In addition, the maps should include natural features on the way. The very best maps and guide books of this character have been prepared for the Yellowstone National Park by Dr. Herman C. Bumpus under the title of "Trailside Notes for Motorist and Hiker," No. 1, Yellowstone National Park, U. S. Dept. of the Interior, National Park Service, 1933. In the instance of New York City and its park environment the automobilist would cross the George Washington Bridge, where, looking north, he would see the



BROWN TROUT FISHING

Dr. Clyde Fisher amid lichen-covered bowlders in the Middle Fork of the Little River in Tennessee



Photograph by E. O. Hovey

SILVER CASCADE

A fine example of stream erosion as seen from the railroad in Crawford's Notch, New Hampshire

ageless Palisades with their suggestion of primeval forces. Looking south, he would view the highest skyscraper in the world. The contrast could scarcely be out-distanced anywhere else on earth.

The "Trailside Guidebook" would answer the question, "What made the Palisades"? It would tell of the great Volcanic Dyke, intruded by the forces of uplift. It would also tell of the forces that brought about the present-day appearance of the landscape—the forces of erosion—the severance of fragments from the cliffs—the breakage of large fragments to small, the grinding producing sand, etc.

Then, still following the map, the motorist would journey on up the Hudson River bank and pause at the Hudson Gateway on the roadside below Dunderberg Mountain, where the panorama would tell the story of "What's What in the Landscape"—the presence of mountains on every hand, of water in the river, cloud and brook, and all the visible elements of the surrounding country.

Following upon this, the motorist would then logically proceed to the Trailside Museum near by, to visit what



Photograph by Clyde Fisher

MOUNTAIN STUARTIA

This typical southern mountain plant, was photographed near Townsend, Tennessee



ALUM CAVE BLUFF

A spot famous to hikers in the South. The figures in the picture give an idea of the tremendous size of the bluff

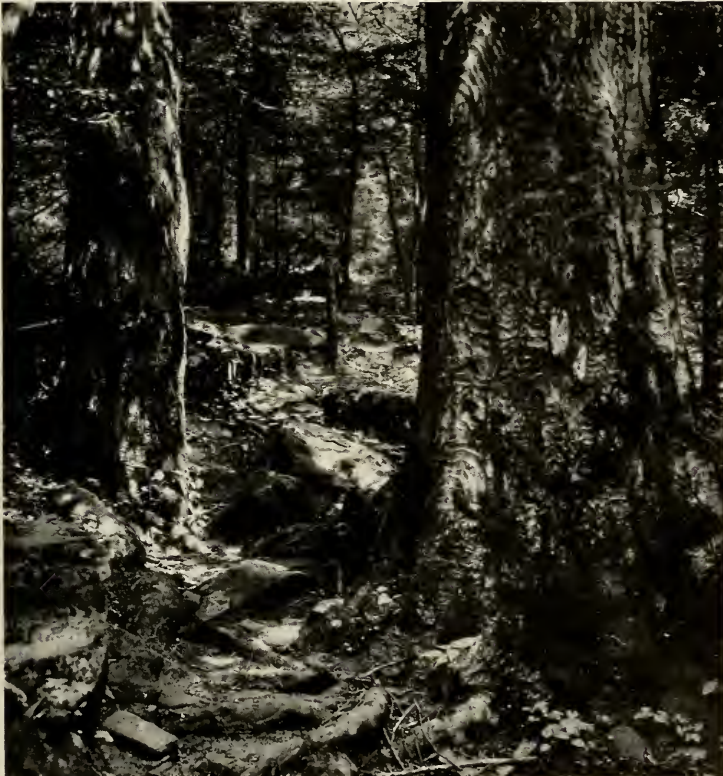


DOMES CASCADES

A scene on the Roaring Fork Creek of Mt. Le Conte—a sylvan spectacle long remembered by those who have sought it out

LITTLE PIGEON RIVER

Another example of water as earth sculptor. Note the ripples, water-worn bowlders, and broken rock upon the sandy beach



START OF THE TRAIL

The rock- and root-strewn trail on the way to Mt. Le Conte's magnificent summit winds sinuously through the sun-flecked forest

Mr. MacKaye terms the "Biologic Garden" where there is presented an exposition of "Who's Who in the Forest." Upon the sides of the Appalachian Trail, running up the mountain, Anthony's Nose, there will be found the answer to the question, "What Made the Forest"? Here, clearly visible, are the stages of forest succession, from lichens to trees. The walkers could then follow the "AT" as far as they pleased in any direction, reading their own interpretation into the landscape sketched before their eyes.

Any attempt at guiding along the Appalachian Trail or elsewhere will fail ultimately unless definite steps are taken to relate interpretations intimately to the walkers directly concerned. It is highly desirable constantly to stress the interrelation and the interdependence of all nature. This phase of the subject has

been treated quite fully in a pamphlet, "Trailside Interdependence," published by The American Museum Press, early this year. The reactions of the visiting public at the Bear Mountain Trailside Museum have clearly demonstrated the advisability of this policy. Here every attempt has been made to encourage guests to realize that they are a part of the great scheme of creation, that without *sunlight, moisture, plants, etc.*, they could not exist. This may seem very elementary. Nevertheless, we consider it of fundamental importance. If, through straightforward but appealing exhibits, a visitor can be encouraged to think along the lines of the interdependence of life, when in the woods, his entire viewpoint changes and he becomes mentally alert to the possibilities of more perfectly relating himself to the world about him.



EASY WALKING

A more civilized portion of the Mt. Le Conte trail



"TUCKY-BELLE"

NIGHT-FLYING HOMERS OF THE SIGNAL CORPS

An Experiment That Resulted in a New Race of
Homing Pigeons

BY CARTER W. CLARKE
First Lieutenant, Signal Corps, U.S.A.

THE War Department has long appreciated the value of a race of night-flying homing pigeons, and shortly after the World War the development of such a race of birds was undertaken by the Signal Corps. Lieut. Carter W. Clarke, of the Signal Corps of the U.S.A., at Fort Monmouth, New Jersey, where the experiments were carried on, tells in the following article the story of their successful achievement.

—THE EDITORS.

AT Fort Monmouth, New Jersey, the Signal Corps of the U. S. A., has developed an entirely new race of homing pigeons. This new race will do what no homing pigeon ever has done before,—take to the air after dark and fly with bullet-like speed through rain, fog, or the blackest darkness.

This work was first begun at the Signal School, Fort Monmouth, New Jersey, and for a long time it was feared that the venture would be unsuccessful. After several years of discouragement, however, those engaged in the enterprise met with some slight success, and today the statement can definitely be made that this work has passed the experimental stage.

These night-flyers have been developed from especially selected parent stock, composed of birds that had exhibited marked twilight-flying characteristics and, in addition, had bred three generations of successful day-flying homing pigeons.

The night-flying loft at Fort Monmouth is separate and distinct from the other lofts, but is no different in construction. The training of the young night-flyers, however, is entirely different from that of their day-flying cousins. They are not allowed out of the loft during the day, but when they have reached the age of about eighteen days, they are taken out on the landing board of the loft just at dusk, permitted to survey the surround-



THE PIGEON LOFT AT FORT MONMOUTH, NEW JERSEY

It was at the Signal School here that the Signal Corps of the United States Army first began to develop a race of night-flying homing pigeons

ing country for a few moments, and then forced to trap.

This continues for several days, after which they are taught to fly. When they have become strong on the wing, at about the age of twenty-one days, they are taken out just at dusk 200 yards from, and in full sight of, the loft and permitted to fly home, where they are fed.

This training is continued for a week, the distance being increased very slightly with each flight, but the flight is made later each day. At the end of this period, training flights are made nightly, the distance being increased each night by one-eighth of a mile until the birds can fly one mile with consistent regularity. The length of the flights is then increased to two miles by successive quarter-mile steps, and thereafter by successive half-mile steps until the maximum flying radius of the bird is attained.

It is the nature of a homing pigeon to

fly only during daylight and to roost upon the approach of darkness. The ordinary pigeon released after nightfall will sit down beside its trainer and wait for daylight before beginning its homeward flight. To avoid such a contingency with the night-flyers, they are not simply released as are ordinary pigeons, but are tossed into the air with considerable force. They then begin their flight and continue flying until they reach their home loft.

At Fort Monmouth five miles is the average distance over which these night-flying pigeons will home, due to atmospheric and other conditions. There are, however, at Fort Monmouth several night-fliers which will home consistently over a distance of sixteen miles. It has been found that an east wind, which adversely affects homing pigeons the world over, also delays the flight of night-flying pigeons.

Much has been written in recent years about the night-flying strain of homing pigeons developed since the World War by the United States Army Signal Corps.

Many of the writers have waxed enthusiastic over this accomplishment and have hailed it as the solution of one of the most baffling of all military Signal Communication problems.

Signal Corps officers, also, had until recently considered the problem practically solved or at least well past the experimental stage. So successful had been the trial night flights of not only the birds of the home lofts of the Signal Corps at Fort Monmouth, New Jersey, but also in Hawaii and our other foreign service stations, that all night-flying training had reached the routine stage.

Thomas Ross, Army Pigeon Expert at Fort Monmouth, and his coterie of pigeoneers recently experienced a rude shock, however, when they made the

almost incredible discovery that it was next to impossible to "settle" the night-flying homers in a new location.

In order to make room for new construction projects at Fort Monmouth, the breeding and training lofts of all the Signal Corps homing pigeons were recently moved to a new location on the reservation. This new area was on the south bank of Parker's Creek, as was the former site, and was about 800 yards due west from the old location.

Under ordinary conditions only about ten days are required to settle the birds in a new location. Thereafter training flights or races may be conducted with the same certainty of success as if the birds had not been moved.

In this particular case, however, the move occurred at the beginning of the mating season, and all the birds, both the night- and the day-flyers, were kept inside the lofts until the young squeakers were



READY—GO!

Sergeant Mike J. Cmar, of the Pigeon Section at Fort Monmouth, is about to release one of the Signal Corps homing pigeons



THE AVIARY

The night-flying loft at Fort Monmouth is separate from the other lofts, but its construction is exactly like them



A BASKET OF "HOMERS"

This photograph shows the type of basket used and the method of handling the Signal Corps homing pigeons when transporting them from place to place



NEW TYPE OF STATIONARY PIGEON LOFT

The work being carried on at Fort Monmouth by the Pigeon Section of the Signal Corps is now considered as past the experimental stage



PREPARING PIGEONS FOR TRANSPORTATION

Members of the Pigeon Section at Fort Monmouth attaching and lacing pigeon corselets. This method is used mostly by the Cavalry while carrying pigeons on horseback



THE PIGEON SECTION OF THE SIGNAL CORPS

The Signal Corps homing pigeon lofts at Fort Monmouth, New Jersey, where the new race of birds is being trained

old enough to start their training flights. Since many times the normal settling period had elapsed when these flights were resumed, it was only natural to suppose that not only no difficulty would be experienced with the older birds, but also that they would act as mentors to the squeakers and materially assist in their training.

It was with no little amazement, therefore, that Mr. Ross waited in vain for the return of his night-flyers after a comparatively short distance "toss." After a lengthy wait at the new lofts, Ross decided to visit the old location, and there he found his A.W.O.L.'s peacefully roosting on the ground on the exact spot where the night-flying lofts had formerly stood.

After pelting the wanderers with small stones and using the lure of the feed can, Ross succeeded in driving the birds to their new home. This occurrence was repeated on several succeeding nights and always with the same result.

It is not uncommon for individual birds

to cause their trainers much annoyance in resettling. This was the case with "Arthur," one of the famous Ross birds which required almost three years to adapt itself to its surroundings at Fort Monmouth.

Ross, therefore, was unperturbed and decided to conduct a few "tosses" with the youngest generation of birds born this spring. These fledglings were hatched in the new location and had never known the home of their forebears. Consequently, Ross began an intensive training program for these youngsters with a view to speedily advancing their night-flying distance to a maximum.

When this had been accomplished, Ross planned to stage a flock toss of both the young and the old timers in the hope that, as sometimes happens, all birds would return to the home lofts.

His amazement, therefore, knew no bounds when he found that these youngsters also returned, not to their paternal roof, but to the former site of the lofts. They, like the older birds, also settled to

the ground at the old location, and, if undisturbed, would have spent the remainder of the night on that spot.

There were many instances in the World War where the possession of a basket of night-flying homing pigeons would have materially influenced the operations. At that time, however, there were no such birds in existence. When immediately after the war the development of this new race of night-flying homers was begun, the Signal Corps had a two-fold objective. The primary aim, naturally, was purely military, but no less important were the civilian aspects of the problem.

It requires no imagination to visualize the inestimable service that a pigeon trained for night-flying could render an aviator forced down on a night trip. Likewise it is obvious that such birds would be invaluable in the event of a great national disaster such as floods, cyclones, or earthquakes where both the normal and auxili-

ary channels of communication have been disrupted.

It is still too early to draw any definite conclusions based upon this unusual performance, but it appears that, from a military standpoint, several generations must yet be bred and trained before dependable night-flying military homing pigeons can be produced.

From the civilian's standpoint, however, the results are most encouraging. Since lofts established at airports or landing fields will be in fixed locations, this newly discovered trait of the night-flyers will increase their value, for much greater dependence can be placed upon them than was formerly deemed possible.

The discovery of this unsuspected characteristic will, however, tend to simplify the training of the night-flyers and eventually may result in developing still another separate and distinct race of birds.



A DETAIL OF THE LOFTS
Roosts in the Signal Corps night-flying pigeon lofts at Fort Monmouth



SQUEAKERS

Seven-day-old homing pigeons in a nesting bowl, at Fort Monmouth

In the early stages of the experimental work in developing the night-flyers, certain birds which had exhibited the most marked night-flying propensities were shipped from Fort Monmouth to Panama and Hawaii, where experimental work was also conducted. As a result, two separate and distinct systems of breeding and training these night-flyers have been established.

The night loft at Schofield Barracks in Hawaii and the methods used there in training the young birds differ in a marked degree from the methods just described. The loft itself is similar in construction to the standard loft used at Fort Monmouth except that the windows and aviary are supplied with curtains that may be lowered to produce a very dim light. There are no lights used within the night-flying loft at Fort Monmouth or upon the landing board and the birds are never allowed out during the day.

The interior of the Hawaiian loft, however, is artificially illuminated by red bulbs as are also the trap and roof. The birds placed in this loft are at all times

accustomed to this dim, red light, they are trained to search for their food on the floor of the loft, and their home is unaffected by either night or day.

A pigeon expects to be fed upon his return from a flight, and if this is not done, or if he is unable to find his food on the floor of the loft upon his arrival, he is disappointed, disheartened, and loses his incentive to do his best when on a flight. The Signal Corps pigeoneers in Schofield Barracks claim that the pigeons require light to find their food, and that the remarkable success attained in Hawaii in training the night-flyers is due to the use of these lights. They may be correct.

In stocking the Hawaiian night loft, young birds old enough to care for themselves but too weak to fly are selected. They are confined in the loft for about five days, during which time the curtains are kept drawn and the lights turned on. At the end of this time the trap is opened, permitting the youngsters to become acquainted with the exterior of their home.

After the completion of the preliminary training period and when the birds have

A MOBILE PIGEON
LOFT

Every facility is provided for the safe transportation of the homing pigeons in these specially equipped trucks



FAMOUS "HOMERS"
"Reingold" (left) captured German bird,
and "Mocker," World War hero, at Fort Monmouth



acquired flying strength, regular daytime flights are held in the vicinity of the loft and the pigeons are permitted to become thoroughly acquainted with their surroundings. This is in marked contrast to the Fort Monmouth method, where the birds are never allowed outside the loft during the day.

These days flights of the Hawaiian birds are made later each day until the pigeons are flying at dusk and finally after nightfall. After about ten days of successful night-flying in the vicinity of the loft, distance flying is begun. This training is begun over a distance of one-eighth mile and is increased by successive steps until a distance of one mile is reached.

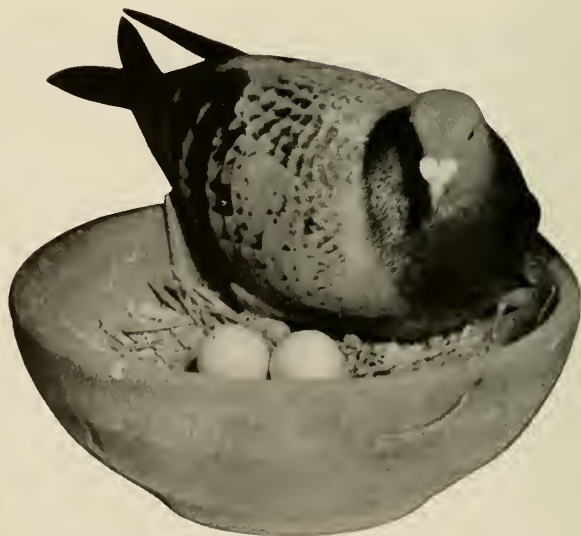
The next flights are of three miles, the first being at dusk and each of the following ones later until the birds finally are flying well after nightfall. Repeating this process at five miles ends this stage of the

training and all subsequent flights are made at night and from greater distances.

The Hawaiian birds consistently made longer flights than their cousins at Fort Monmouth, but the pigeoneers at the latter station claim that this is due not to the method of training, but to the fact that the Hawaiian birds, located on an island, are aided in holding their course by the sound of the ocean and by the phosphorescent glow of the tropical waters.

While the use of lights in the lofts and on landing boards may be of considerable value during the early stages of development of the race, it is obvious that lights could not possibly be used in the war zone.

Consequently, it is not at all improbable that in the future the two separate systems of training will be continued: the one using lights in and on the lofts to care for the civilian requirements, and the other for the combat requirements of our Army.



NEST BOWL AT THE SIGNAL CORPS PIGEON LOFTS



A PAIR OF SMALL
SPOTTED BARBS

PETS FROM TROPICAL WATERS

Tropical Fishes of Widely Different Habits and Appearance Which Have Recently Become Highly Popular Among Those Who Maintain Home Aquaria

By CHRISTOPHER W. COATES

The New York Aquarium

PHOTOGRAPHS BY S. C. DUNTON, COURTESY OF THE NEW YORK AQUARIUM

THE amazing popularity which has recently overtaken the keeping of small tropical fish in home aquaria is especially remarkable because these fish are for the most part not inexpensive. The hobby has received a tremendous impetus during the past three or four years. It may be that the increasing number of fish-keepers is comparable to the current rise in the popularity of jigsaw puzzles, for both of these avocations call for expenditure of more time and attention than of money.

Whatever the reason, the keeping of miniature tropical fresh-water fishes in the home has taken on the proportions of a small tulip mania, for these fishes, imported from all parts of the tropical world, are to be found in the most unlikely places. Recent press dispatches announce that a large proportion of the business offices of such inland metropolises as Chicago and Cleveland are now equipped with

small aquaria in which a selection of fishes find sanctuary, while dentists and doctors all over the country are increasingly using these little animals to entertain their patients as they await their turn.

To the person who is at all inclined toward natural history, these fishes appeal in the *nth* degree, for their form, color, habits and the ease with which they are studied are arresting, and frequently startling. It is not so easy to account for the popularity of the fishes where the amateur aquarist has no leaning to natural history. Perhaps it is because the fishes come from places with romantic names, and the devotees experience a vicarious thrill of travel by transplanting some of the fauna of Siam or the Cameroons into their drawing rooms; or perhaps the aquarist is pleased with his rôle of sole arbiter of the lives and deaths of his finny pets!

The keeping of these small foreign fish had its inception as long ago as 1869,



THE SAIL-FIN, *MOLLIENISIA VELIFERA*

One of the live-bearing tooth-carps, wherein the males are frequently more ornamented than the females, in this species with an enlarged backfin

when a traveler, attracted by the remarkable nesting habits of a little fish living in the rice-field ditches of China, sent a few to France as novelties. From that time on, a few fishes from time to time captured the fancies of other travelers, until now there are scores of men, versed in fish lore, scouring the tropical waters of the world for fishes which are suitable inhabitants of a container of several gallons capacity. An industry which is rapidly assuming major proportions is founded on the efforts of these collectors—the manufacture of aquaria, thermometers, fish food, nets, and specially constructed electrical lighting and heating equipment. This is employing more and more factories, and the distribution of these articles as well as of the fishes is the support of a small army of people. With almost every fast passenger ship from Europe carrying at least a few cans of fish, the importation of

these little animals is great, but the importers are facing considerable competition from the breeders of the fishes, for many of the fish breed freely in the small aquaria to which they are consigned and there are many establishments wholly devoted to the breeding and wholesale sale of tropical fish in this country.

The fishes themselves are really remarkable creatures. Of a vast diversity of shape, they are of every color in the spectrum, and while many of them are related, there are scarcely any that duplicate the habits of their cousins. Some of them are fierce, unapproachable beasts, in spite of their small size, while others are as peaceful as a flock of sheep. The main difference between them, however, is in their courting and nesting habits, which range all the way from a casual mating, lasting but a few seconds, to an association lasting for weeks, and sometimes months, during which period the

infant fishes receive a maximum of parental solicitude.

It is a curious, and perhaps a significant fact that while the fishes under consideration were named and classified primarily on taxonomic characters, these rather artificial and arbitrary divisions are followed through by what, for want of a better name, we shall call the mental lives of the animals. For instance, we do not know of any species of carp which exhibits the slightest interest in its own eggs or young, except as a possible meal, while all the cichlids of which we have any knowledge, devote a considerable amount of their time and energy to the raising of one family after another, tending them against all sorts of possible and impossible enemies. These fishes, for instance, will attack the hand of a man which approaches their nest too closely until the young fish are half as large as the parents. In fact, to such an extent has the care of the eggs and young of this

family proceeded, that there are many species of African cichlids that carry the fertilized eggs about in their mouths until they hatch—a matter of about three weeks, during which time the parent takes no food at all. The buccal sanctuary is not closed against the fry after they are hatched, for the parent will allow them to swim about her until danger threatens, then will open her mouth again for the youngsters to enter and remain until in the judgment of the parent, there is no further danger to them. Such parental solicitude is not confined to one sex. Sometimes it is the male which carries the eggs about and sometimes the female, and each is perfectly content, as far as any indications show, with what the other is doing.

The American cichlids—this family occurs mainly in South America and Africa although there are one or two representatives in southern Asia—do not carry their eggs about, but deposit them



A PAIR OF SIAMESE FIGHTING FISHES

It is said that in Siam males of this fish are pitted against one another like game cocks



A BARB (*Barbus*) FROM SOUTHERN ASIA

This is one of many species of similar fishes found in water tanks and such places in India and adjacent regions. Their small size, attractive coloring, and activity make them well suited to the aquarium

in a nest guarded by both parents until the babies hatch. Then the whole family, sometimes numbering several hundred, is carefully escorted about their

aquarium, each straggler being immediately returned to the school. This goes on for weeks and woe to any fish of even twice the size of the parents that approaches the small cloud of young fish. The parent fishes will turn and rend the intruder with the utmost ferocity.

What social or racial consciousness prompts such self-sacrifice on the part of these fishes is hard to imagine, for there are many other fishes, just as successful biologically, which scatter their eggs about haphazardly, and with no knowledge or consciousness of parental care.

The species which are kept in aquaria, quite free of the obvious dangers to which the youngsters may be exposed, continue in their elaborate precautions against the onslaught of other fishes, although the parent fishes must know that there are no other fishes in the aquarium. The habits seem, therefore, to be blind and unthinking.



THE VICIOUS PIRANHA

One of the so-called cannibal fishes of South American rivers. Their rather small mouths are set with very powerful teeth

From another family that does not ordinarily pay much attention to its eggs or young, comes a fish with another example of care of the spawn, although we do not know that this species devotes any time to the preservation of the young after the eggs have hatched. This is *Copeina arnoldi*, a characinid. For a reason not at all clear to our philosophy, the fish deposits its eggs above the water-line, on a convenient leaf or stone, the pair leaping up together for the actual spawning. Sometimes two or more deposits of eggs are made during the same spawning, after which the female goes about her affairs as though there were no such thing as an egg in the world. Not so the male. He spends the next two days or so splashing water up on to the eggs every few minutes, hiding a short space away during the intervals when he is not watering the eggs. The next splashing after the eggs hatch washes the baby fish



THE GLASS-FISH

A native of Southern Asia. These fishes are so translucent that their internal structure is plainly visible

into their rightful element, and the male fish then pays them no further attention. Again this remarkable habit is carried over from the wild into the aquarium,



THE SCALARE

An ornamental fish from Brazil belonging to the cichlid family. American cichlids guard their eggs and young

although we do not know why. It may be that the eggs require a certain amount of desiccation, but if so we would be put to it somewhat to explain how it is that the fish discovered this unusual requirement!

These various habits are not, of course, confined to the little fishes which inhabit our drawing-room aquaria. They are to be found, in one fashion or another, wherever fishes are studied, but the fact that the aquarium fish will live, court, and die, without any major adjustments, in our small glass tanks, has added an invaluable tool to science, and an amazingly popular introduction to natural history to the layman, who, until he purchases his first pair of guppies, is completely, and perhaps happily, unaware of such occurrences. After he has established his first guppy, he is usually on the way to establishing an aquarium limited only by the space available, or the size of his purse, for what is more natural than that he should, after watching his female fish deliver twenty or thirty living babies

and then eat them immediately, acquire another aquarium to use as a nursery. Then he exchanges tales of his fish with other people equally interested, and they recommend the addition of this or that fish, for its interesting habits or its color or some other peculiarity, and then the process is repeated. He has often to find room for another tank or two.

It may be news to many people that there are fishes which have living babies. There is one whole family of such fishes, all of which occur in the Americas or the adjacent islands, and there are many other fishes, not exactly aquarium specimens, which have the same interesting habit. Some of the sharks are viviparous, as well as a few skates, but our concern is with the small fishes which may be easily kept in the facilities available in every home.

The "live-bearers," so-called because they have families of little fishes instead of depositing eggs about the tank to hatch at a later period, are all small fellows,



THE BLACK-BANDED POECILID, *LIMIA NIGROFASCIATA*

One of the so-called "live-bearers," which have families of little fishes instead of depositing eggs



A GYMNOTID EEL FROM SOUTH AMERICA

There are a number of species of these strange eels, related to the larger electric eel which is capable of giving a powerful electric shock

some of which are very beautifully colored. They are considerably tolerant of the abuse they frequently receive, and they reproduce with amazing rapidity. Most of them are mature at six months or less, when they start delivering broods of youngsters every month or so with little or no effort on the part of the fish fancier. The little fellows, hardy and adaptable, grow rapidly, but they seem to disappear with equal rapidity, for the fanciers, in spite of the number of young ones they raise in their own tanks, tax the tanks of the professional fish breeders to their utmost. At least, there is a continual demand for even the commonest of these little fishes. It is true, no doubt, that many of the young are used to feed other rarer fishes which refuse to eat prepared foods, preferring to catch their own meals on the fin, so to speak, but the keepers of such carnivores are a very small minority of the total of fish fanciers, so we still cannot account for the disappearance of so many little fishes. It is hard to find an aquarist who will admit that he loses fishes

for any reason, unless his tanks are in danger of decimation from some cause he cannot understand. Then he calls for assistance, of course.

This is not always easily given, in spite of the best will in the world, for there are so many causes for death of any animal, and it is so difficult to trace the original cause to its source, that only the most general advice may be repeated, with general hints as to the best maintenance of the tank as a unit.

While these various types of care of the young were developing in the western world, another remarkable nesting habit was developing in the East. This is the very curious nest of the labyrinth fishes, a floating raft of air bubbles manufactured by the fish into which the eggs are thrust as they are liberated. The eggs are not deposited in the nest, but deliberately placed there by the male parent. The female will do this if she is allowed by the male, but he is usually so much larger and fiercer than she is, and so jealous of his prerogatives, that she is invariably driven



THE PIKE-LIKE *BELONESOX*
One of the live-bearing tooth-carps from Central America with the shape and predacious habits of a pike

the price of the latter has dropped from about thirty dollars a pair to three dollars or so in the past few years. A good specimen is a truly spectacular fellow. The body may be deep blue, or red, green, or fleshy pink, and the fins, of an even more intense color than the

away from the vicinity of the nest, and returns at considerable peril. If, for any reason, she can get a few eggs, she will do so, and will watch that they do not fall out of the small nest she will build, much as will the male, but her efforts are not as constant as those of the male.

The curious part of the whole affair is that the baby fish hatch just as well without attention as they do under the constant ministrations of their father, and the little creatures, when they are hatched, are just as likely as not to make a meal for the parent fish.

There are several species of this family suitable for keeping in home aquaria. The paradise fish which was sent from China to France during the last century, the forerunner of all pet tropical fish, is one example. The widely known Siamese fighting fish is another. These fishes breed freely in small domestic tanks, so freely, in fact, that

body, are flowing banners, bigger than the fish itself. Such gorgeous creatures as these are the product of the aquarium. The wild fish are not nearly as large; they do not have the large fins, and while a suggestion of great color is apparent, the fish is usually a dark, nondescript color not at all pleasing to the eye.

What brought this fish into notice was not the color, but the amazing pugnacity of the beast. Stories are current that in Siam two males of this species are thrown into the same tank and left to fight it out between them, wagers being laid on the result. However, the fancy aquarium-bred fishes are not nearly so

THE CLIMBING PERCH

It is said that this inhabitant of southern Asia comes out of water after a shower of rain and invades gardens in search of earthworms



ZEBRA FISH, *BRACHYDANIO
Kerio*

From India. An attractive, active member of the carp-minnow family, long a favorite in aquaria



vicious. They do fight between themselves on occasion, but the fighting is more or less confined to snipping bits of each others' fins. While this is not dangerous to the life of the animal, it spoils his looks, for the fins regenerate showing scar tissue which ruins the clear sweep of the rays of the fins. It is only the males which show the large fins, although the females have the same brilliant coloring, perhaps in slightly less degree than a male of comparable heritage.

The most usual way of keeping these small tropical fishes is in communities of as many species as the aquarist can procure as long as the fish will live amiably together, but both the paradise fish and the fighting fish are too large and bad tempered for the community aquarium, although one and sometimes two specimens may be kept with other fish if the tank is fairly large—say ten or twelve gallons capacity. There are, however, a few

gouramies, fishes of the same family, with the same general nesting habits, which will live in perfect peace with many other fishes. These will, quite frequently, build their nests in the tank, successfully defending them against any fish which approaches, but when the babies are hatched and start wriggling about the aquarium they will be eagerly snapped up by any other fish that may happen upon them. The best way of securing a few youngsters is to place a pair of the fish in a tank of several gallons capacity, and after the spawning, remove the female. This leaves the male free to keep his mind on the eggs, which fall out of the nest in

sufficient numbers to fully occupy him, retrieving and replacing them, until the youngsters hatch and are freely swimming about the tank. Then he, too, should be removed, for the temptation to feast on myriad living fishes may overcome his parental feelings, and



THE MUD SPRINGER

A fish which spends much of its time hopping actively about on mud flats or even relatively dry ground in pursuit of insects or the like



THE PARADISE FISH

A native of China. One of the labyrinth fishes which place their eggs in a floating raft of bubbles constructed by one or both parents, usually by the male

there will be no babies left in a very short while.

While the greatest interest of the aquarist is, perhaps naturally, in the breeding behavior of his pets, very many people are solely concerned with their decorative value. In a properly arranged aquarium, this is very great, and many men have gone to great pains to bring out all the lovely colors and shapes of the varied fishes. Aquaria have been built into walls, with elaborate picture molding affixed to the opening, the total effect being of a living "pond-scape," for the variety of greens and shapes of the different aquatic plants combined with the vast assortment of vivid and pastel colors of the fishes make a really beautiful display. Such arrangements call for considerable ingenuity in the lighting of the aquarium, for a large amount of light will encourage the growth of microscopic plants, valuable in themselves,

but of no æsthetic beauty, and too little light will inhibit the growth of the major plants, a thing to be deplored. However, the right balance is not hard to achieve and the finished work well repays the lover of beauty.

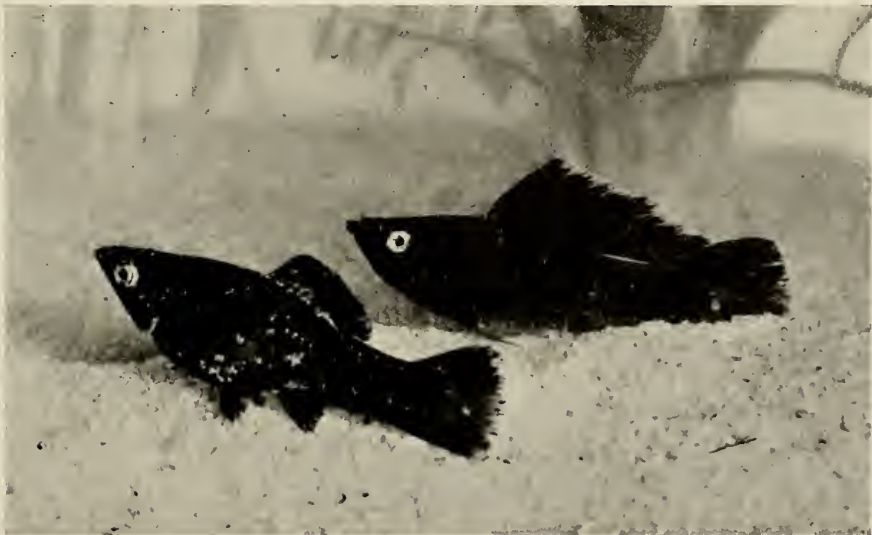
There are one or two fishes whose claim to a small popularity is based on their rather extraordinary feeding habits. These, in the majority of fishes, are not particularly interesting; a small portion of food of one sort or another is dropped into the tank, and the fishes eat it, but some fishes will not eat any food unless it is alive and moving, and is of a fairly large size. *Belonesox*, one of the viviparous top minnows from parts of Central America, refuses to eat anything but small fishes. These, unconscious of their fate, swim about until the pike-like larger fish, opening his mouth, seems to slide right over them. The leaf-fish *Monocirrhus polyacanthus*, of the Amazon,

likewise refuses any but living fishes. His approach, however, is considerably more subtle. Shaped and colored like a dead leaf, with the fins which give him motive power quite transparent, he drifts about until he is within striking distance of his victim, when the tremendous mouth opens, the pectoral fins fan a terrific, irresistible stream of water through the mouth and out the gills, and the unfortunate small fish is literally sucked into the yawning cavern.

Of still more spectacular feeding habits are those fishes which depend on the flies they can catch. One of these, the archer fish, *Torotes jaculator*, a somewhat rare fish from the East Indies, actually shoots his prey,—small flying insects, with a drop of water ejected with considerable force and deadly accuracy. Mr. Chute, director of the Shedd Memorial Aquarium in Chicago, finds that small specimens of this species can project a drop of water about eleven feet, although the limits of accurate firing are about three feet. The fly, suddenly struck with a drop of water, falls to the surface, where the fish im-

mediately seizes it. Another fly-catching fish with a much wider habitat is the mud-springer, *Periophthalmus*. This fish is found from western Africa to the eastern coasts of Australia, along tropical coastal mud flats. It has developed its pectoral and ventral fins into something remotely resembling paddles or flippers, on which it sits and hops about entirely out of the water, returning only to bathe itself and fill the water reservoir at intervals of perhaps thirty minutes. While it is on land it leaps about with the greatest agility, catching and devouring prodigious quantities of mosquitoes.

However, while such fishes are obtainable, they are comparatively rare, and are not to be found in the ordinary domestic aquarium, although they will live there if any are secured. Most amateur aquarists are satisfied not to have these fish-eating and jumping fishes about their homes, for the first are not content without a few guppies every day, and the latter may jump out of an aquarium and never be able to jump back again, faults which make them undesirable as pets.



BLACK MOLLIE—A BLACK FORM OF *Mollienisia latipinna*

*Photograph by
E. Paravicini*



A COASTAL VILLAGE
BUILT ON AN ARTIFICI-
ALLY ENLARGED CORAL
ISLAND

AMONG THE MOUNTAIN BUSHMEN OF MALAITA

Invading a Primitive Wilderness in the Cause of Science

BY WALTER J. EYERDAM

THE chain of islands lying in the Pacific Ocean known as the Solomons is one of the relatively few spots in the modern world where life is still remarkably primitive. The island of Malaita is one of this group.

Since its discovery by Alvaro Mendaña in 1567, Malaita has reputedly harbored some of the bravest and most warlike savages that inhabit any of the islands of the Pacific. It still, retains, therefore, the lure of the little-known, for no explorer had penetrated into the interior of the island until the Whitney South Sea Expedition entered in 1929. Only a few white men have crossed Malaita, and their trips were hurried ones.

The Reverend Norman Deck, a missionary to Malaita, claims the distinction of being the first white man to cross the island fifteen years ago. He took care not to stop at native villages to rest. Since then several other people, including Dr.

W. Mann, American naturalist, have made the venturesome trip. When Jack London and Martin Johnson visited Malaita during the course of their South Sea voyaging in the "Snark" in 1917, the small boat in which they went ashore was covered by riflemen in another boat.

Many years ago it was not an uncommon occurrence for the natives to board small ships lying off the coast, kill the crews, and carry off the cargo. This gruesome practice has been stopped only by the intervention of the British Government, for the salt-water men learned to fear reprisal parties.

The native men of Malaita are among the strongest, most active, and willing workers in Western Melanesia. Many of them have long been used as indentured workers in Queensland, Fiji, former German Samoa, and the British Solomons. They are intelligent and quick-witted and know how to drive a hard bargain.

Their villages are neat and clean, and one finds there more modern accessories adopted from the white man than in any other islands of the Solomon Group. However, it is said that in the mountain districts, where the arm of the British law does not reach, head-hunters and cannibals still occasionally carry on their barbarous practices.

A treacherous method of retribution formerly used on Malaita was the employment of professional killers, who could be hired for a small sum. It was a common practice for a man to take what he considered justice into his own hands, and to punish graft, theft, and other social offenses by having one of these killers do away with the offender quickly and quietly. Arissimai and Bassiano were two of the most notorious killers of modern Malaita. It was said, probably with very great exaggeration, that Bassiano had to his credit more than one hundred heads, while Arissimai—who was said to have been a real man-eater—had sixty-five.

According to Henry Kuper, who lives on Santa Anna Island and who had met Arissimai on more than one occasion, this bloodthirsty native slept in caves or in deep forests by day and prowled around by night. He was usually accompanied by two subordinates who assisted him with his nefarious work. One day, about sixteen years ago, when the people of the district still were cannibals, Mr.

Kuper's vessel was anchored near a small village on San Cristobal Island. Shortly before, Arissimai had landed in the vicinity and had been seen with two wives that he had brought over from Malaita. He was soon found and chased out of the bush by a crowd of natives from whom he escaped to his canoe, after killing one man. The infuriated savages seized the two wives, and Mr. Kuper, watching, saw them kill and dismember and start to cook the women.

Perpetual feuds between the mountain bushmen and salt-water men have served to keep both these tribes hostile and ferocious.

Malaita could well be named The



Photograph by R. H. Beck

THE "FRANCE"

At anchor at one of the collecting stations. This schooner was owned and operated by the American Museum for about ten years



Photograph by H. Hamlin

A WAR CANOE OF CHOISEUL ISLAND

Such canoes have, in the past, played a large part in the activities of the natives of the South Seas

Island of Bachelors, for about twenty-five per cent of the men never can get enough worldly goods together to purchase a wife or "mary" as a woman is generally called. A "mary" costs about a hundred pounds sterling, and usually only those "boys" whose families have considerable wealth can purchase a "mary." A boy will sometimes work on plantations for ten years, striving to save enough money out of a wage of one pound per month for this purpose.

The men of Malaita are, as a rule, strict in their morals, and with few exceptions, are monogamists. They punish adultery severely, and formerly both guilty parties were sometimes sold into slavery to a neighboring tribe.

A Malaita wedding is indeed a gala occasion with much feasting on pigs and other local food. It is at this time that the groom makes the necessary payments

to the father of the bride. Cash payments are made in the form of strings of red and white shell money, shillings, calicos, and ornaments. Sometimes the groom is so heavily indebted to relatives and other members of his clan that he and his wife must spend the rest of their lives making the payments. At the wife's death if some money is still due any relatives, a last attempt is made to liquidate the debt by confiscation of such heirlooms as she may have had.

It is remarkable that among the Melanesians in the British Solomons there are practically no white half-castes except the few born from legitimate marriage.

Only a year and a half before the Whitney South Sea Expedition visited Malaita there occurred the Sinerrango massacre. Mr. Bell, the District Officer, and his lieutenant, Mr. Lillys, with their patrol of fourteen police boys had been

ambushed and massacred by the natives Bassiano and Noru and their followers. Five hundred salt-water men and salt-water bushmen, hereditary enemies of the mountain bushmen, with a handful of white men in command, were sent out on a punitive expedition. These, together with a large body of native police, formed the expedition against the defenseless people of Sinerrango, which lies on the east side of the Island. A considerable number of this community were killed, their gardens uprooted and villages burned, and about two hundred were taken prisoners. These were interned at Tulagi, tried, and punished. Bassiano was among those captured and, with seven of his followers, was brought to Tulagi and hanged. Bassiano was credited with putting up a courageous fight to the end.

The Whitney South Sea Expedition, of which I was a member from 1929 until 1930, spent more than three years in studying and collecting birds on the Solomon Islands. Malaita was the last island of the group to be visited. Our party, consisting of Messrs. H. Hamlin, Wm. F. Coultas, Ernst Mayr, and myself, after spending about one and one-half months on the coast of Malaita collecting birds, were extremely anxious to try the wild, mountainous interior. This would be our only chance to find additional rare and new species of birds on the island.

The District Officer at

Auki told us that he could not guarantee safety from the natives of the interior, for that part of the country was entirely out of the region controlled by the government. He gave us a very discouraging description of the natives, emphasizing their sullen insolence and treachery. However, we were determined to go in spite of all protests, if we could get native carriers.

After we had negotiated with a bush chief for a week he finally agreed to send twenty-three of his people, including three young women, down to the coast. From here they carried our luggage on a two-days' journey inland up the Kori-ekwa River to the bush chief's village, where we



Photograph by H. Hamlin

BOW OF A LARGE CANOE ON CHOISEUL ISLAND

These beautiful craft are ornamented with wood carvings, sea shells, and mother-of-pearl inlays. Very little of such handiwork is now in evidence

stayed a week. But in this district we found only the same kinds of birds that we had collected on the coast.

On the fourth day of our stay at this village there appeared two mountain bush boys who were related by marriage to the chief. Mr. Hamlin induced them to guide him back into their country so that he could attempt negotiations for us with the chief of their tribe for permission to hunt birds. He returned about three days later.

Just before reaching the village of Aurola, Mr. Hamlin had suddenly found himself surrounded by a crowd of natives all well armed with Snyder rifles, axes, clubs, and spears. Among them was a

chief who demanded to know what Mr. Hamlin's mission was. Upon learning, he seemed well pleased and said that he and his men had heard of the "France," our expedition schooner. They were interested in our quest for birds and he could see no reason why we should not be welcome to his people. He said that since the Sinerrango massacre the natives were out of tobacco, and were anxious to purchase calico and other trade goods.

Accordingly, Mr. Hamlin triumphantly escorted Charlie Babamai, the chief of Aurola, Hankapan John, a devil-devil man or sorcerer, and twenty-two mountain bushmen back to the hill village where we anxiously awaited him.

The next day we were off to the interior of Malaita into a region hitherto untrodden by white men without police protection. Two days later we pitched camp near the top of Mt. Torumbusu at about 4000 feet elevation. We remained at this camp for a most uncomfortable week, for it was the time of the equinoctial storms and we had continuous cold, wet, and foggy weather. Forced, on account of the weather, to establish another camp, we chose a near-by village, while Mr. Hamlin returned to the coast and Coultas and I lived with the mountain bushmen for a month.

We camped six hours' march from Aurola village. The chief with whom we associated proved to be very reliable and trustworthy, a man



Photograph by E. Paravicini

THE SON OF ARISSIMAI

The father of this man was one of the most notorious killers of Malaita Island

*Photograph by R. H. Beck*

WELL-DRESSED

A group of native women, from Santa Anna Island, adorned with inherited family treasures

in whom we could put perfect confidence. This was indeed most fortunate, for had it not been for him and old Hankapan John, the devil-devil man, it might have gone hard with us. Many of our native porters were bold fellows and most of them had lost relatives in the punitive expeditions that followed the Sinerrango massacre. Even John, the devil-devil man, told us that his wife had been decapitated during the fight. He apparently loved her and would sometimes weep when mentioning her.

For our safety we trusted to luck and to the good will of the bushmen, but to keep in their favor we allowed them to help themselves to our food and to use all of our six shotguns for hunting birds. At night we always had fifteen or twenty visitors stopping with us, and we had to let them use all of our excess clothing, blankets, socks, and canvas, to keep warm.

Our bed was made of rough pales, but Coultas and I had blankets.

From a distant village came one of the professional killers to pay us a visit. Fortunately, by being firm but just in our dealings with the native porters and by keeping them in good humor, we had won their confidence before this sullen individual appeared. He continually tried to stir up trouble against us. In order to show that I did not fear him and wished to be friendly, I let him have one of my shirts and use my gun. In return he insisted upon sleeping with me for two nights. Needless to say I did not relish this idea, but was quite sure that he meant no harm.

Our provision of two hundred pounds of rice lasted about two weeks, but there were always plenty of birds to be had, and nearly every day several young native girls would come to sell loads of yams and taro.

*Photograph by E. Paravicini*

A MALAITA LANDSCAPE

Coastal vegetation on coral ground near a village

Some of these little females were beautifully formed and as healthy as could be. A hundred-pound girl could tote a heavy load of produce over the roughest mountain trails, going so fast that a white man of good endurance—empty-handed—would have all he could do to keep up with her. They did not mind the hard work of being porters, and would laugh and smoke along the trail. In camp at night in stormy, cold weather, they would lie, naked and shivering, on the wet ground, while the men had clothes to cover them.

Had the chief taken a dislike to us and wished to obtain our baggage and equipment he could have done so by the simple expedient of calling a strike. Without porters we should have had to abandon everything and wander back to the coast over wild mountains where practically no trails existed.

Although we had heard much of the treachery and cruelty of the mountain bushmen, we learned to like them in many

ways. They are a simple and industrious people, whose mode of living has not progressed much beyond the days before the white man's advent. Their wants are few and their code of morals strict. In driving a sharp bargain they are unexcelled, but like most warlike primitive people they possess a higher standard of honor than many civilized people. We never lost a penny's worth of anything by theft while with these people, and could leave an article unguarded no matter how precious and valuable it might be in the eyes of the natives.

We lived in the chief's big house and were a source of great wonder to his neighbors. Natives kept coming from distant villages to look at us, and often brought flying foxes, phalangers, and birds.

The mountain people have melodious voices and the men often sang in beautiful harmony accompanied by reed pipes and other instruments. The rhythm is

THE BURIAL PLACE
OF A HEAD-HUNTER

The funerary structure
that supports the re-
mains of Arissimai,
notorious head-hunting
chief

*Photograph by
E. Paravicini*



GRUESOME
MEMENTOS

A burial cave for skulls
on Vella Lavella,
Solomon Islands

Photograph by R. H. Beck



peculiar but pleasing to the ear. Often while Coultas and I were skinning birds very late at night some of the warriors would start to sing. Their normal time for retiring was shortly after sundown, but they were too polite to tell us to go to bed. Two natives with the euphonious names Sumburagene and Okamouri were always the leaders of the orchestra, and they could sing beautifully. The words of a song were usually invented by the singer as the music progressed. Bassiano, the great killer now in the spirit world, had become a mighty hero. His deeds of daring were extolled in song, and great were the praises sung to the soul of Bassiano as warriors and young boys sat around the fire recounting his bloody deeds.

At last we were ready to leave the mountain bush country, and going over

the steep mountain trails to the east coast of Malaita, came out at the village of Kwarambara in the Ulimburi district, where we met Mr. Hamlin and prepared to rejoin the schooner "France."

Besides obtaining a very large and fine collection of marine, land, and freshwater shells, many of which were new to science, we collected many insects, reptiles, frogs, fishes, and crustaceans. The collection of birds consists of 1060 specimens, representing 62 species, 16 of which are indigenous forms new to science. These have recently been described by Dr. Ernst Mayr in *Novitates* published at the American Museum of Natural History. A considerable series of flying foxes, bats, and phalangiers or cuscus were also collected, representing the mammalian fauna of Malaita.



Photograph by E. Paravicini

A SCENE NEAR THE COAST

A jungle on the banks of a coastal stream. The hot and humid climate breeds plenty of mosquitoes



Photograph by J. Ogilvie

Victoria Falls

COLLECTING WILD BEES IN SOUTH AFRICA

The Work of a Group of Entomologists in a Field Rich in
Insect Novelties

BY T. D. A. COCKERELL

University of Colorado, Boulder, Colorado

RETURNING from our long African journey, we were naturally keen to know the scientific results. As we got more than sixteen thousand insects, it will be readily understood that complete returns will not be available for a very long time, if ever. Within the last few years, several of the insects collected by Darwin during his famous voyage in the "Beagle" (1831-36) have been described as new, and every little while we see described some species found by Wallace in the Malay Archipelago. The insects are so numerous that the entomologists, working as hard as they may, cannot classify them all. Many centuries must pass, I suppose, before we know the insects of the world as well as we now know the birds.

Reaching home on January 8, I at once went to work on the bees of the expedition, and up to the time of publishing, have found in the collection 140 new ones. Of

these, 5 are from Angola, 40 from the Belgian Congo, 3 from S. Rhodesia, 3 from the Transvaal, 4 from Natal, and 85 from the Cape Province. In the regions other than the Belgian Congo and the Cape Province, our stay was short, with about four or five collecting days in each. But in the Belgian Congo we had about fifty-six days, and in the Cape Province about a month. Thus it appears that for the collector of bees, South Africa is considerably richer in novelties than Central Africa, and this is indeed the case. Bees are always most numerous and interesting in dry countries, such as North Africa, Turkestan, and the American Southwest. In South Africa, the best collecting we found was in the dry region about 150 miles north of Cape Town, the region of Calvinia, Nieuwoudtville and Van Rhyn's Pass. Here we got more than forty new species.

When my wife and I left Cape Town at



Photograph by R. H. Compton

THE KARROO GARDEN AT WHITEHILL

This garden is located nearly two hundred miles from Cape Town in the dry interior where only a few inches of rain fall yearly. The garden was established in order to assemble a collection of desert succulents

the end of November, Miss Mackie and Mr. and Mrs. Ogilvie remained behind. They have since visited many localities which we did not reach, collecting diligently, and sailed for England from Beira, on the east coast, June 4. Their collections will undoubtedly add greatly to the list of new bees.

Sakania was our last collecting point in Belgian Territory, and thence we traveled south by train to Victoria Falls. Thus, we passed through Northern Rhodesia without obtaining anything, except a few small specimens here and there while the train stopped.

Victoria Falls deserves all the praise it has received; it would be hard to imagine any more beautiful scenery. The Zambezi flows placidly among numerous small islands, and is suddenly precipitated into a deep gorge at right angles to the river, the water flowing out at the north end in a narrow, winding channel. When the river is in flood, there is so much spray

that it is impossible to see much, but we were there in the dry season, and had a perfect view, permitting Miss Mackie to get an excellent cinema photograph, which has been shown to hundreds of people in Colorado. We were able to go in a native canoe to Livingstone Island, where David Livingstone first saw the falls. One end of this island is on the actual brink, and affords an excellent view in both directions. From a biological point of view this locality is interesting on account of the so-called rain forest, a small area which is wetted by the spray at all seasons of the year, and so has a peculiar and luxuriant flora. This is not a particularly good place for bees, but there are some snails which may prove to be restricted to this locality. On the convolvulus flowers near the Falls we found a very active bee in some numbers. It proves to be new, and has been named *Lithurgus livingstonei*, after the discoverer of the Falls. At the hotel we saw

a notice asking for subscriptions to a monument to Livingstone, to be erected at the Falls. We all felt that this would be a mistake; there can be no better monument than the Falls themselves.

From the Falls it is more than 200 miles southeast to Bulawayo. Here may be found the Rhodesia Museum, in charge of Dr. G. Arnold, who is a distinguished authority on the wasps and ants of South Africa. The Museum was in process of being enlarged, and the insect collections were temporarily housed in a sort of annex, but I was able to study and list the excellent series of bees. We went by way of Gwelo to Zimbabwe to see the famous ruins, and we hoped to collect in quite a new locality. It was very hot when we left Bulawayo, so we left our warm clothes at the hotel, a procedure we soon had occasion to regret, for it turned cold and stormy, and we had no warm weather at Zimbabwe at all. The collect-

ing accordingly was very poor, though we did get one new bee. Travelers in Africa should be warned against these sudden changes of temperature, and of the fact that they are perhaps more likely to suffer from cold than from heat.

Pretoria, in the Transvaal, could not be described adequately without a special article devoted to the subject. It and Cape Town are the two great intellectual centers in Africa south of the Sahara,—the two places where there are numerous experts, where the collections and libraries are adequate for research. Pretoria has the Transvaal Museum, containing among other things the great Brauns Collection of South African bees, and also the University and various departments connected with economic zoölogy and botany. The principal local entomologists are G. van Son, who keeps the collections at the Museum in first-class order, and is doing important work on certain groups of



Photograph by R. H. Compton

A CHARACTERISTIC SOUTH AFRICAN PLANT

The shrubby *Protea barbigera*. Only a few forms of the family Proteaceæ are found north of the equator. Fossils of Tertiary age prove that they once abounded in Colorado

moths; Professor Janse, one of the most learned students of moths now living; Professor Faure, whose work on the life-history of locusts has given astonishing results of great biological interest; and G. A. H. Bedford, a well-known specialist on parasitic insects and ticks. To these should be added Professor Lounsbury, formerly of the United States, who has now retired, after rendering great services to South Africa by his work in economic entomology. Also at Pretoria we met Mr. Herbert Lang, of the famous Lang and Chapin Congo Expedition of the American Museum. He told us much about the Congo, and aided us in a variety of ways. One item of advice deserves to be passed on to future travelers. In the Congo we suffered severely from "chigger" fleas (*Dermatophilus penetrans*). They mainly attack the feet and according to Mr. Lang they can be easily kept away by the use of flake naphthaline in the shoes. Had we known this, we might have been saved from much discomfort.

In general, I was so favorably impressed by Pretoria that I should like to go back, and work there for six months. Another six months might very profitably be spent at Cape Town.

In the low-lying country along the eastern border of the Transvaal is the

Kruger National Park, dedicated to the preservation of the native fauna. It is 211 miles long from north to south, and has an average width of 37 miles. There are some hundreds of miles of roads, and rest camps where it is convenient to spend the night. We left the train at Nelspruit, and drove through the Park for three days. In this time we saw twenty-three lions, numerous giraffes, very many zebras, and many kinds of antelopes. Wart hogs were very numerous and in the river we were able to watch the hippopotamus. All these animals are perfectly free and behave as they doubtless used to do before they were molested by man. They show little fear of automobiles, and can be approached near enough to get good photographs. Miss Mackie took a cinema picture of a large male lion in the grass close to the road, waving his tail. This was our first lion; he was seen sleeping on the grass, and it was difficult to make him get up. Later we saw a lioness with her kill,—a wildebeest or brindled gnu. She was accompanied by her large cubs, and vultures were sitting in the tree above, awaiting their turn. Another lion was limping painfully, perhaps having been kicked by a zebra.

The only new bee we got in the Park was a *Tetralonia* which my wife collected while we were having lunch at the Pretorius Kop Gate.

Going on to Durban, I was particularly interested to visit the Durban Museum, as, during many past years, I had corresponded with Mr. E. C.

AN AMERICAN CACTUS

This cactus from South America (*Opuntia maxima*) was introduced into the South African desert, and is becoming a menace to native vegetation which cannot compete with it



Photograph by Alice Mackie

COLLECTING NEAR
VICTORIA FALLS

An interesting ground where some new species were obtained. Professor Cockerell visited here during the dry season

Photograph by Alice Mackie



Chubb, the director, and he had published for me many papers on Natal bees. This Museum is a municipal institution, and exists for educational rather than research purposes, although some important researches have been carried on. As an educational museum, it could hardly be excelled, and we were greatly pleased with all we saw. The Natal Museum at Pietermaritzburg, under Director Ernest Warren, is also most excellently arranged. Here may be found the important Burnup Collection of South African land shells.

While we were in Durban we chanced to meet Capt. W. T. Walker of Greytown, Natal, and he persuaded us that we must not leave Natal without seeing this place. When we told people where we were going, there was some disposition to scoff, for the locality is in a relatively barren upland country, largely planted with wattle trees. Also, the season was extremely dry. When we arrived, the outlook seemed anything but promising, but we found our way to the small botanical garden (where we noticed some of our red sunflowers, which originated in Boulder, Colorado) and went to work. The results were surprising, and that one hot day in Greytown gave us as good a catch, judging by the number of species, as we got anywhere. Two have proved new to science. The next day the rains began, and we left, knowing that the good collecting was over for the time being.

The Australian wattles are grown all

over this country for their bark, used in tanning. The species is, I understand, *Acacia mollissima*, better known as *A. decurrens*. In recent years this tree has been greatly injured by a native bagworm (*Acanthopsyche junodi*), very similar to the common species of the United States. It must have come from the native acacias in the lowland country, and could perhaps be controlled by native parasites from the same source.

Leaving Natal, we traveled far, to Graaf-Reinet on the edge of the Great Karroo in the Cape Province. This was our first introduction to the dry region with its remarkable flora of succulents. Here we met Mr. Robert Luckhoff, who is equally interested in the succulents and in collecting the extraordinary fossil cynodont reptiles, for which the region is noted. These reptiles, extinct many millions of years ago, are believed to be ancestral to the mammalia, and hence to man. We got eleven new bees at Graaf-Reinet, some of them very different from anything we had seen before. A short stay at Port Elizabeth gave us four new bees and some interesting snails, and a day's visit to Uitenhage, a short distance up the line, was extremely successful, producing nine new species, two of which were also found elsewhere. This place is



Photograph by J. Ogilvie

A LION IN KRUGER PARK

It is estimated that between 400 and 500 lions exist at present in Kruger Park. As they have plenty to eat there is little occasion for attacking man. Professor Cockerell and his party carried no weapons at any time in Africa

noted for the abundance and variety of the wild flowers.

We now went more than two hundred miles westward to Oudtshoorn, on the other side of the Karroo, passing on the way Willowmore, long known to students of bees as the home and collecting ground of Dr. Hans Brauns, a very skillful amateur entomologist, equally indefatigable in his pursuit of insects and in the practice of medicine. Had he been still alive, we must of course have visited him.

Oudtshoorn proved an excellent locality, producing as many new kinds of bees as Graaf-Reinet. We had the great pleasure of meeting Archdeacon Whaits, well known for his discovery of many new fossil cynodont reptiles, and a most delightful personality. Inspired by our example, his son and daughter, Philip and Althea, went out for an hour or two to collect bees. They had the luck to catch a new carpenter bee, and I have named it *Mesotrichia whaitsi*.

We now went south to the coast, collecting near Camfer and on Montagu Pass, with very good results. Here we first saw in abundance some of the characteristic South African plants, especially various species of shrubby *Protea*, with large flowers. These represent a family of plants especially abundant in South Africa and Australia, and with only a few forms north of the equator. They once abounded in Colorado, as may be seen from the fossils of Tertiary age. We also found cycads in a gulch on Montagu Pass,—another ancient family with fossil representatives in the Mesozoic rocks of our Western States. Some of the European flowers have run wild, and look rather out of place amidst the southern flora. We noted the briar rose (*Rosa rubiginosa*) and the scarlet pimpernel (*Anagallis arvensis*). At Port Elizabeth and Uitenhage we saw the blue pimpernel, which is so common in the Island of Madeira.

At the British Museum, just before sail-

ing, we met Miss J. St. Leger, who is an authority on African mammals, especially rodents. She said: "If you go to George, do call on my father." We amiably said "Yes," but at the time such a visit seemed remote and improbable. However, we reached the south coast at George, early in November, and introduced ourselves to Dr. St. Leger, who took the keenest interest in our proceedings, and drove us to interesting places in the neighborhood. He took us to see the ravages of the large Suturoid moth, *Nudaurelia cytherea*, the caterpillars of which are very destructive to the plantations of pine trees, and are said to have killed about 200,000 trees. They were being gathered in buckets and destroyed. The larva is a very handsome one, with very dark red head, red marks on back, and blue and yellow dots; there are very small spines on tubercles. It makes no cocoon, hence the generic name, given to it by Rothschild.

The South African Museum at Cape Town is an old and well-known institution, long the center of zoological activity.

Dr. A. J. Hesse, in charge of the department of entomology, has the insects very well arranged and classified, including the bees, though he does not specialize in this group. There are, indeed, no special students of wild bees in Africa at the present time. This seems surprising, considering the abundance and attractiveness of these insects, and their interesting habits. There could hardly be a more fertile field for a young entomologist desiring to accomplish something of value.

The botanical center near Cape Town is at Kirstenbosch, the Kew of South Africa. The National Botanic Gardens contain a very fine selection of the native flora, especially noteworthy for the number and variety of the Proteaceæ. Here also is the Bolus Herbarium, where technical studies are carried on, and from which many important papers are published. In spite of all the work that has been done on the unique flora of the Cape Peninsula, there are still things to be discovered, and we were told that two quite distinct new heaths had just been described.



Photograph by J. Ogilvie

GIRAFFES IN KRUGER PARK

The giraffe sometimes escapes notice as the broken pattern simulates to some extent the lights and shadows coming through the branches. When a giraffe runs, however, it is bound to attract attention



VICTORIA FALLS FROM
LIVINGSTONE ISLAND

It was from here that Livingstone first saw the Falls. Professor Cockerell and his party reached this spot in a native canoe

Photograph by Alice Mackie

This dry country, as one travels over it, recalls Arizona, New Mexico, or Southern California. There are numerous hills or small mountains, and valleys between. As in our Southwest, the dry arroyos are flooded when there are heavy rains, but in general there is little moisture. The aspect of the country, for hundreds of miles, is very uniform, yet for some reason not readily explained, many of the desert plants are very local, and consequently intensive search results in the discovery of numerous new species. As these flower only for a short period, and are in any case very difficult to preserve as herbarium specimens, it is absolutely necessary to study them in the living condition, and such a garden as that at Whitehill makes it possible to work out the characters of the various species. Careful records are kept concerning all the plants, and the work done is as exact and thorough as it can be made, but, unfortunately, this cannot be said of all the current work on succulents. These little plants have of late years become very popular in Europe and elsewhere, as they are easily grown and one can have a nice little garden in a bowl, though living at the top of a ten-story flat. One result of this has been the removal of many thousands of these plants from their native habitat, with the

possibility of exterminating rare and local forms. Another has been the describing and naming of species from specimens obtained through the trade, having no exact data, a proceeding very confusing to botanists.

A more serious danger to the Karroo flora comes from the grazing of sheep and goats. These animals destroy the plants of one locality after another, and must ultimately impoverish the whole area. Still another evil is the spread of the American prickly pear cactus (the common one is, I understand, *Opuntia maxima* from South America), which was seen covering many miles of country, and taking the place of the native vegetation, which cannot compete with it. There was a discussion going on in the newspapers as to the advisability of importing some of the insects which have been so efficient in destroying prickly pear in Australia. I believe this is being done, but one objection was raised,—that the prickly pear fruits were an important source of food for the natives.

Thus the Karroo flora, which seems at first sight to be protected by its environment from destruction, is actually in serious danger, at least in many parts of the country. There should be established fenced-in reserves at numerous points where both plants and animals could develop as they did in early times, without interference from the greatest of all pests, man.

We do not always realize how nicely the balance of nature is maintained under

ordinary circumstances, and yet how easily it can be upset. Conditions created by man may lead to the inordinate increase of a species, with disastrous results. Apparently slight changes may lead to extinction. Fossils show us that many forms of life were once more widespread than at present, while many more have totally perished. One result of our South African work was the discovery of a very extraordinary case of discontinuous distribution in a group of bees. The genus *Hesperapis*, with rather numerous species, is characteristic of the arid regions of our southwest, especially New Mexico, Arizona, and Southern California. The genus *Capicola*, of which we found several new species, is characteristic of the similarly arid regions of South Africa. Now a close comparison reveals the astonishing fact that *Hesperapis* and *Capicola* are one and the same genus, though of course the species are distinct. This type is too peculiar to have originated independently in two remote places, so we can only suppose that at one time it extended across Asia and Africa, through regions where, so far as we know, it is now totally lacking. Thus, over a vast area, it must have been exterminated. A rather different example is that of the tsetse flies (*Glossina*), now an African group, totally unknown elsewhere, except that one species reaches the southwest corner of Arabia. But millions of years ago tsetses lived in Colorado and no less than four species have been found fossil there.

RAIN FOREST AT VICTORIA FALLS

Spray from the Falls keeps the surrounding area damp at all seasons of the year, which causes a peculiar and luxuriant flora to flourish

Photograph by Alice Mackie

Our last expedition was north from Cape Town to Calvinia and Nieuwoudtville, where we had more success than in any other region. The flowering season was nearly gone and people said we should have arrived two months earlier. Undoubtedly this region, and the country northward as far as the Angola border, will produce an almost incalculable harvest of entomological novelties, with many strange types not to be found elsewhere.

We left Africa with regret. In all our long journey, we had met with great kindness, and in no case had occasion to be afraid, either of man or beast. The friends we made are among the finest people we know anywhere. We found great scientific activity in certain places, and at present it may be said that Africa has reached a stage unusually favorable for scientific work. The first pioneer work has been done, and the organization of zoölogical and botanical research has been carried far enough to enable the student to understand the nature of the problems involved, and classify his materials without so much to do and discover that he is almost overwhelmed by the riches coming to his hand. Regions which quite recently could be reached only with difficulty and at great expense, are now traversed with comfort and with very moderate



expenditure. The entomologist, at least, has no need to collect great sums for his undertaking. We found that a little more than five dollars a day per person would suffice, not counting the sea journey. The small hotels proved comfortable, and those in charge were usually indefatigable in serving us.

We feel a little offended, now, when our

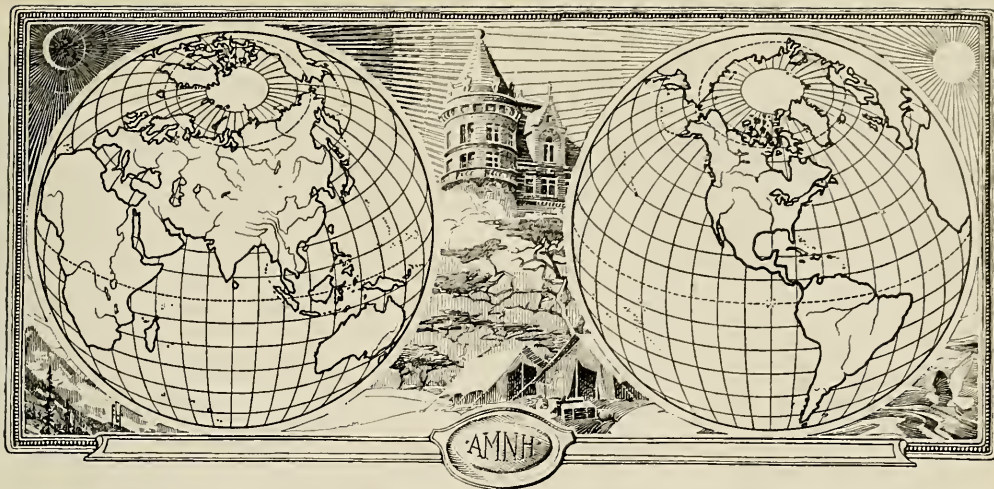
friends at home talk about the Dark Continent, thinking of it as a land of mysterious evils and dangers. It is not that today, but rather a land of sunshine and flowers, kindly people and beautiful beasts. It has its many problems and serious evils, like every other land, but these make it all the more interesting to the sympathetic observer.



Photograph by R. H. Compton

A PLANT WHICH FLOURISHES IN THE KAROO

It is almost impossible to distinguish *Pleiospilos bolusii* from pebbles, but where two apparent pebbles are close together, they really are a plant



SCIENCE IN FIELD AND LABORATORY

American Museum Activities—Expeditions—Meetings of Societies
Other Museums—New Publications

EDITED BY A. KATHERINE BERGER

ASTRONOMY

ON May 17 the Amateur Astronomers' Association held its annual meeting for the year 1933, and elected the following officers:

President, Dr. Clyde Fisher
1st Vice President, Dr. Clement S. Brainin
2nd Vice President, Mr. Oliver P. Medsger
3rd Vice President, Dr. R. E. Lee
4th Vice President, Dr. O. H. Caldwell
Treasurer, Mr. Charles J. Liebman
Secretary, Miss Marian Lockwood

Members of the Executive Council elected were as follows:

Mr. Stansbury Hagar
Mr. William Henry
Dr. John A. Kingsbury
Mr. A. Cressy Morrison
Mrs. Virginia Geiger
Mr. Leo Mattersdorf

The next meeting of the Association will be held on Wednesday, September 20, at which time Dr. Clyde Fisher, the president, will speak on "Meteorites and Meteor Craters." The officers of the Association are pleased with the schedule for next year, which includes Dr. Harlan T. Stetson, Dr. Charles P. Olivier, Dr. John A. Miller, Dr. Annie Jump Cannon, Dr. Clark Wissler, and other famous scientists.

All those interested in the Association and its work are invited to write for information to Miss Marian Lockwood, Secretary, Amateur Astronomers' Association, American Museum.

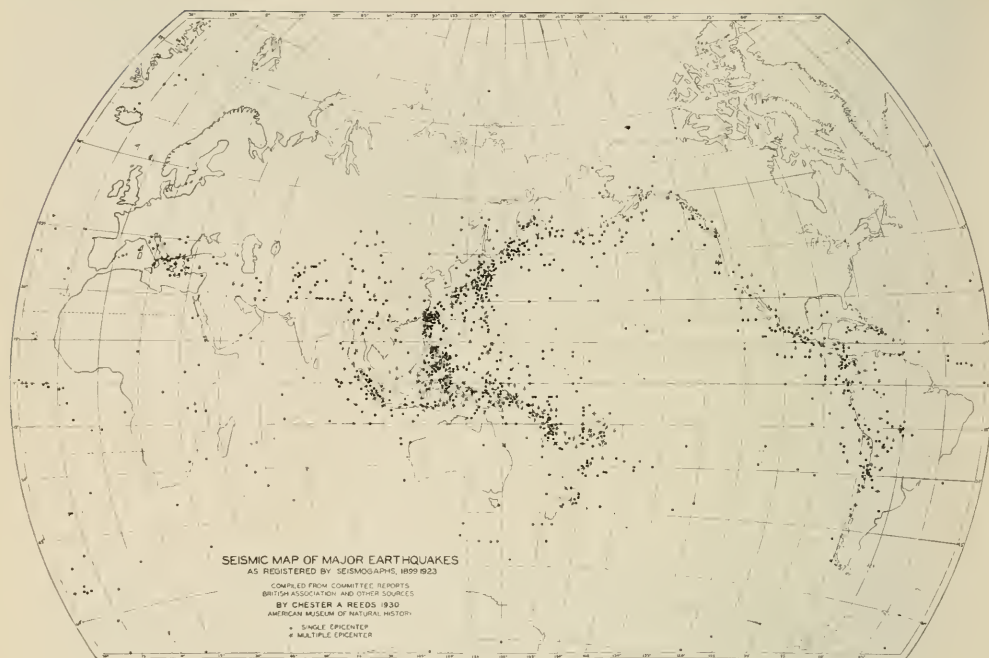
INSECTS

WHITE ANTS.—There has recently been considerable newspaper publicity and consequent anxiety among householders concerning termites or "white ants." According to some

accounts, termites are new things in the vicinity of New York City. This is utterly false. Some more moderate accounts claim merely an increase in the damage done. This may be true but it is far from certain.

Our native termite lived peacefully and well in fallen timber before there were houses on Manhattan. When European man came, some of the termites accepted the advantages of civilization and moved into his houses, but most of them staid in stumps and logs out of doors. With the spread of civilization there are fewer stumps and more houses. The result has been a decrease of rural termites and possibly, but not certainly, an increase of urban dwellers. Nevertheless, it is quite probable that a smaller percentage of man's houses have termites now than had them in the old days when humans built more largely of wood without good foundations.

If you think that you have termites in your house or wish to build a house that will not suit these interesting relatives of cockroaches, write to the Bureau of Entomology, Department of Agriculture, Washington, D. C., or to your state entomologist. In case you are not certain as to the identity of your guests, send the unbiased authorities specimens of the suspects and do not trust to describing the insects merely as "flying ants." True ants, as well as termites, fly at the mating season. There is a possibility that some really troublesome species of termite may reach us from the Tropics. If so, the governmental authorities should know about it; but every



A TWENTY-FIVE-YEAR MAP OF MAJOR EARTHQUAKES

Showing the location of 1783 major earthquakes as registered by seismographs for the twenty-five-year period 1899-1923

insect in your house is not an actual or even a potential enemy and not every "insect exterminator" knows termites.

HISTORY OF THE EARTH

A TWENTY-FIVE-YEAR MAP OF MAJOR EARTHQUAKES.—On May 15, 1933, the American Museum Press published a seismic map of the world showing the location of 1783 major earthquakes as registered by seismographs for the twenty-five-year period 1899-1923. A small-scale copy of the map is reproduced on this page. The solid black dots on the map show the location of single major disturbances, while the circles, with one or more radiating spokes, show spots where large earthquakes have occurred repeatedly. Each spoke represents an earthquake. To the east of New Guinea near the intersection of the 165° E meridian and the 15° S parallel there is a wheel-shaped symbol with as many as sixteen spokes. Numerous similar symbols occur in the Pacific Ocean off the eastern coast of Asia and to a minor extent off the western coast of North, Central, and South America, and in the Caribbean Sea to the south of the Greater Antilles.

The map shows that most earthquakes originate in rocks beneath the oceans and that they are confined for the most part to two great belts, one running from west to east through the

Mediterranean and Caribbean seas, and the other adhering to the margins of the Pacific. The great ice wastes of the polar region, being underlain by ancient rocks, are, for the most part, free of them. During this twenty-five-year period ten large quakes occurred north of the Arctic circle, the farthest north being within seven hundred miles of the Pole. Within the Antarctic circle only five were recorded.

The greater portion of the data used in the preparation of this map has been compiled and published in list form by the Seismological Committee of the British Association, part by the Dominion Observatory, Canada, the Seismological Society of America, the former International Seismological Committee, and other organizations.

Only the epicenters of large quakes are shown on the map. If the smaller quakes were plotted, they would show a similar distribution. The number of quakes per year, including large and small, is about 4000. They average about 10 a day, but only 2 per cent are dangerous. During the twenty-five-year period noted, the various types of registered quakes may have totaled 100,000, of which only 1783 were major shocks, that is, those which produced earth-waves which were recorded at stations situated more than half way around the earth from the point of

origin. Of this number about a dozen occurred off the Pacific coast of the United States proper, 10 in the southwestern states, and 6 minor disturbances in the northeastern states. During this period, the Atlantic coast of this country was free of major earthquakes.

Prior to the development of modern seismographs by John Milne and his associates in the late Nineties, our knowledge of the occurrence of earthquakes was confined to the destruction wrought by them on land. Due to the progress which has been made in the past thirty-five years in the development of seismographs, and the study of earthquake records, we now know that most earthquakes originate beneath the oceans and in those parts where geomorphic changes are taking place. During the twenty-five-year period represented by the map, the zones of frequent and infrequent seismic disturbances have been delimited, buildings and building codes designed to withstand earthquakes have been devised, and in some regions, notably Japan, some progress has been made in the prediction of earthquakes. That sudden fear, however, which grips one when an earthquake occurs, has not been removed, and there is some doubt whether it can be deleted.

Historical records show that a total of about 13,000,000 human lives have been lost, and hundreds of millions of dollars worth of property destroyed by earthquakes occurring on the land or near the margins of the sea. Notable instances are those of Lisbon, Portugal, 1755, and of Yokohama and Tokio, Japan, 1923.

—CHESTER A. REEDS.

CONSERVATION

STEPHEN T. MATHER MEMORIAL.—Affixed to a large granite boulder on Bear Mountain in the Palisades Interstate Park, there is a bronze tablet which memorializes Stephen Tyng Mather, the first director of the National Park Service. This tablet was unveiled on May 27 by Mrs. Franklin D. Roosevelt in the presence of a large gathering of park executives and distinguished guests, which included Mr. Mather's widow and

his daughter Mrs. Edward McPherson of Ithaca. Secretary of the Interior Harold L. Ickes flew from Washington for the dedication.

In paying tribute to Mr. Mather and the great work which he conceived and carried out, Mr. Ickes said among other things:

It is keeping well within the bounds of truth to say that our great system of national parks and State parks, providing, as they do, a means of outdoor recreation unequalled in the history of the world, is largely due to the love of humanity and of nature that burned deep within the soul of Stephen Tyng Mather.

To do what he did it was necessary not only that he love the mountains and forests and all the beautiful handiwork of nature, it was equally necessary that he should truly love just people. And it is hard to say whether he loved nature more than people or people more than nature. It is probably well within the truth to say that he loved both of them equally and that when he had them in conjunction he loved them both supremely.

Secretary Ickes referred to Mr. Mather's career of civic service while he was still engaged in business in Chicago, and told how, in 1915, Franklin K. Lane, then Secretary of the Interior, called him to Washington and placed the National Park Service in his hands. And on that day, said Mr. Ickes, when he became responsible for the growth and development of the national parks, a new era dawned in those great recreational spaces of beauty and charm.

The tablet shows a bust of Mr. Mather against a background of trees and mountains, and is inscribed with the dates of his birth and death, July 4, 1867 and January 22, 1930. It is further inscribed:

He laid the foundation of the National Park Service, defining and establishing the policies under which its areas shall be developed and conserved unimpaired for future generations. There will never come an end to the good he has done.

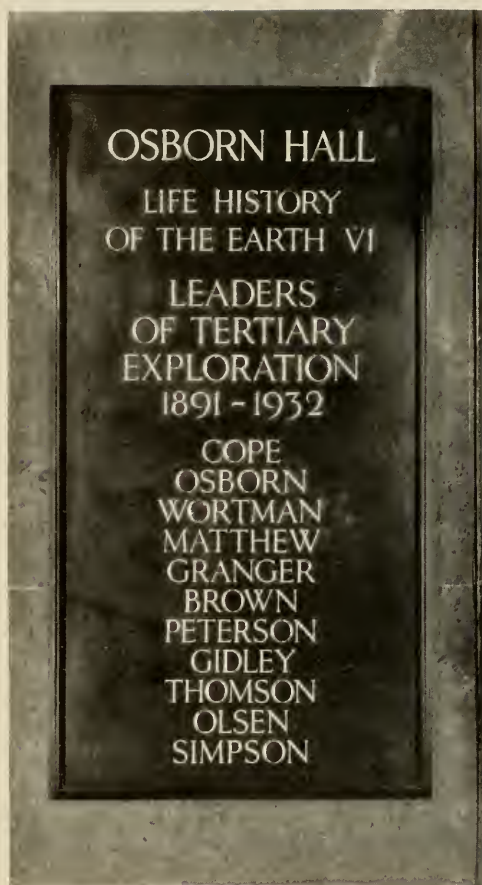
The memorial was designed and cast for the Stephen T. Mather Appreciation, an organization of which John Hays Hammond is chairman.

The dedication ceremonies came at the conclusion of the annual meeting of the National Conference of State Parks.



THE MEMORIAL TO STEPHEN TYNG MATHER

Unveiled at Bear Mountain in Palisades Interstate Park by Mrs. Franklin D. Roosevelt. Left to right are Secretary of the Interior Ickes, Mrs. Roosevelt, and Mrs. Stephen T. Mather



RECENTLY UNVEILED AT THE AMERICAN MUSEUM
A bronze tablet on which are memorialized the names of
men who have made the Osborn Hall of Vertebrate Palaeontology possible

VERTEBRATE PALAEOLOGY

TWO bronze tablets, the gift of Honorary President Henry Fairfield Osborn to the Osborn Hall of Vertebrate Palaeontology, were unveiled on March 6 in the American Museum of Natural History. These two tablets are the first of a series which will be placed at the entrances to the various halls of vertebrate palaeontology, to memorialize the names of the friends through whose aid the collections were made possible. The idea of commemorating those whose coöperation means so much to the success of the whole project was conceived by Professor Osborn.

Curator Barnum Brown unveiled the tablets at a gathering of the entire membership of the department of vertebrate palaeontology.

Director Sherwood opened the ceremony with the remark that the department of vertebrate palaeontology had been Professor Osborn's first love, so to speak, and that more of his

thought had gone into its growth than into any other hall in the Museum. In it he has worked out a model hall showing the history of life on earth that could well serve as a pattern for other halls in the Museum.

The Trustees desiring to show recognition of his invaluable services to the Museum, adopted the following resolution:

WHEREAS, Professor Henry Fairfield Osborn has devoted more than forty years of his life to the establishment and development of the Museum's collection of vertebrate fossils, until at the present time it is without equal in the world, and

WHEREAS, through his explorations, his researches, and his writings he is the outstanding figure in increasing our knowledge of the past life on the earth, and through his dissemination of this knowledge has popularized this branch of science so that every school child now has a concept of the animals of the past, and

WHEREAS, Professor Osborn is chiefly responsible for the superb collections and effective installations in the Age of Mammals Hall, which include the unique series of specimens showing the evolution of the horse, also the unparalleled series of fossils showing the relationships of the *Titanotheres*, which are the basis of his monumental Monograph on the *Titanotheres* recently published by the United States Geological Survey, and containing the results of more than twenty years of earnest research,

RESOLVED, That in partial recognition of Professor Osborn's boundless energy and broad vision in bringing the Age of Mammals Hall to its present unsurpassed standard of excellence, the Trustees hereby take deep satisfaction in dedicating the Age of Mammals Hall to HENRY FAIRFIELD OSBORN and hereby direct that it shall be designated as the *OSBORN HALL OF THE AGE OF MAMMALS*.

Dr. Walter Granger then spoke reminiscently of the early history of the department and the growth of the collections. He told of his first contact with Professor Osborn when, as a youth of seventeen, Doctor Granger came to the taxidermy department of the American Museum. At that time Professor Osborn had come to the Museum from Princeton to establish the department of vertebrate palaeontology which through his scholarship and enthusiasm was destined to raise this institution to a position head and shoulders above any other in so far as vertebrate palaeontology is concerned.

Doctor Granger traced the dramatic progress of Professor Osborn's work to its climax today in the splendid halls and collections now housed in the American Museum.

Professor Osborn in a brief address paid tribute to the self-sacrificing zeal of the members of the department in devotion to their work, and he felt that, whereas there is a disposition in the world to wait until people die before recognizing their worth, he wished to memorialize these workers while they were still living.

President Davison accepted the gift of the two tablets from Professor Osborn for the American Museum on behalf of the Trustees.

LOWER INVERTEBRATES

MR. John Armstrong left in June for Barahona, Santo Domingo, in the interests of the American Museum, to continue his studies

during the coming summer of the invertebrates of that island, with special reference to corals and crabs.

MAMMALS

PHIPPS-BRADLEY EXPEDITION, ANGOLA.—

Favorable reports have been received from time to time from the Phipps-Bradley Expedition in Angola. Some 342 small mammals and 130 birds are now on their way to the Museum, and since the splendid work was started about a year ago by Mr. Bradley more than one thousand mammals have been collected. Mr. Phipps joined the expedition in May of this year.

Relative to this last shipment, Mr. Bradley writes:

The mammals all were taken within a radius of ten miles about Chitan. . . . I do not believe that I have obtained as large a variety in this last collection; the high grass and rains of the wet season are a considerable handicap, but I was successful in securing several species formerly not represented by sufficient numbers. In this collection, too, there are five species of bats. It seems a pity that although there must be many more varieties in that locality, I saw no others. . . . This time I included several small shrews and mice (which were really too small to prepare properly) in alcohol and also a very insufficient group of parasitic insects in a small bottle.

It was not possible to penetrate the Mossamedes district in the truck which I have used here, it being very unsuitable for travel over desert sands. Perhaps when Phipps comes we shall go there. At last I have heard that he is on his way and will arrive May 14th. You may easily guess how pleased this information makes me.

ASSISTANT Curator Robert T. Hatt of the department of mammals, accompanied by Mrs. Hatt, sailed on May 23rd for England to spend several months studying mammals in the British Museum and other European museums. This study is in connection with his work upon the Lang-Chapin Belgian Congo collections, upon which he is reporting.

REPTILES AND AMPHIBIANS

BROODING HABITS OF LIZARDS.—At the sixteenth Annual Meeting of the American Society of Ichthyologists and Herpetologists held at Cambridge, Massachusetts, Doctor Noble reported some experiments on the brooding habits of lizards. Since these reptiles utilize their organs of chemical sense in identifying their eggs, they make far fewer mistakes than birds that depend primarily on vision.

Assistant Curator Pope reviewed his recent studies on Old World pit vipers and also summarized the important contributions made by Wall to the herpetology of India.

SCIENCE OF MAN

WILLIAM W. HOWELLS, associate in physical anthropology at the American Museum, is spending the month of July in the Southwest where he will make a study of the physical characteristics of the Indians of one of the Rio Grande pueblos.

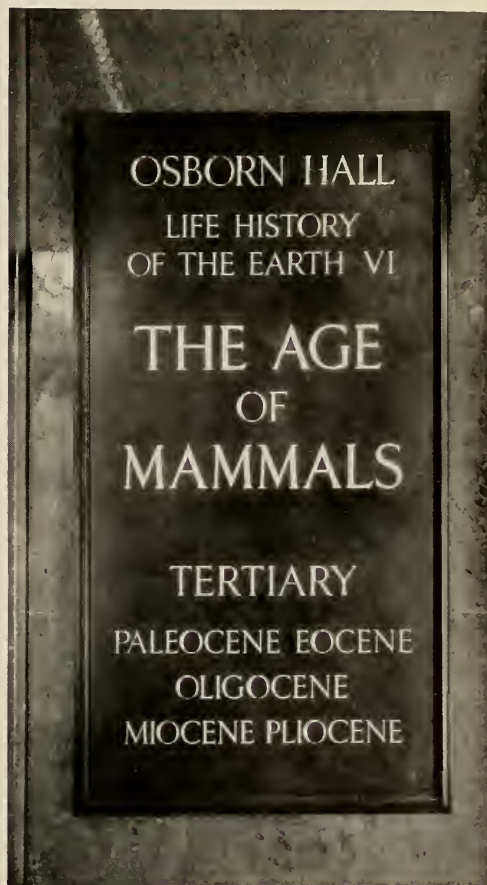
HONORS

AT its June commencement, Yale University conferred upon Lincoln Ellsworth the degree of Master of Science.

AT the sixteenth Annual Meeting of the American Society of Ichthyologists and Herpetologists held at Cambridge, Massachusetts, May 11-12, 1933, Dr. G. Kingsley Noble of the American Museum staff was elected president of the Society.

MEETINGS OF SOCIETIES

THE Sixteenth International Geological Congress will hold its general session in Washington, D. C., from July 22 to 29 inclusive. Through the courtesy of the Chamber of Commerce of the United States, the Congress will hold its meetings in the Chamber of Commerce building at 1615 H. Street N.W., Washington,



THE SECOND BRONZE TABLET

Which has been placed at the entrance to the Hall of Vertebrate Paleontology in the American Museum

D. C. Between July 5 and July 22 there will be offices for registration as follows:

Washington: Chamber of Commerce of the United States, 1615 H. Street N.W.

New York City: Geological Society House, 419 West 117th Street.

San Francisco: State Division of Mines, Ferry Building.

All correspondence should be addressed to the General Secretary, Sixteenth International Geological Congress, United States Geological Survey, Washington, D. C. The cable and radio address in Intergeol Washington.

On July 21 a luncheon in honor of foreign guests, followed by a brief welcoming meeting, will be given by the American Museum of Natural History. There will be opportunity during the day for those interested to visit other local institutions, including the American Geographical Society and the American Institute of Mining and Metallurgical Engineers. The entertainment committee of the Museum consists of President F. Trubee Davison, Henry Fairfield Osborn, Director George H. Sherwood, Herbert P. Whitlock, and Chester A. Reeds.

AT the Chicago meeting of the American Association of Museums, June 12-14, the American Museum of Natural History was represented by Assistant Executive Secretary Wayne M. Faunce. Mrs. Grace Fisher Ramsey presided over the Education Section during the discussion of the subject "How Are Educational Practices of Museums Keeping Pace with the Changing World?" Miss Dorothy A. Bennett was one of the discussion leaders at a general session arranged by the Education Section on the subject "The Museums in Adult Education."

DOCTOR Clyde Fisher, curator of astronomy at the American Museum, attended the meetings of the American Astronomical Society which were held in Chicago, June 21 to 24. While in Chicago, Doctor Fisher paid a number of visits to the Adler Planetarium.

MADAME ZELIA NUTTALL

THE death of Madame Zelia Nuttall on April 12th in Mexico City deprived Mexican archaeology of one of its most distinguished students. From an early age she was interested in the ancient civilizations of Mexico, and in 1886 she brought out her first major publication, "The Terra Cotta Heads of Teotihuacan," *American Journal of Archaeology*, Vol. 2. In 1888 she initiated the *Papers of the Peabody Museum of Harvard University*, her essay "Standard or Head-dress," being Number 1 of Vol. I, of that series. In the course of nearly a half-century of active research she enriched our knowledge of the past in Mexico by no less than sixty-two illuminating

papers covering a wide choice of subjects. A few of the more important titles will give a scanty idea of the remarkable range of her interests:

"The Atl-Atl or Spear-Thrower of the Ancient Mexicans," *Papers of the Peabody Museum*, Vol. I, No. 3, 1891; "Ancient American Superstitions," *Journal of American Folklore*, 1895; "Chalchihuitl (jade) in Ancient Mexico," *American Anthropologist*, Vol. 3, 1901; "The Fundamental Principles of Old and New World Civilizations," *Papers of the Peabody Museum*, 1901; Codex Nuttall, Peabody Museum, 1902; "The Book of Life of the Ancient Mexicans," University of California, 1903; "New Light on Drake," Haklugt Society, Series ii, Vol. 24, 1914; "The Gardens of Ancient Mexico," *International Garden Club Journal*, Vol. 3, 1918; "The Aztecs and Their Predecessors in the Valley of Mexico," *Transactions of the American Philosophical Society*, Vol. 55, 1926; "Documentary Evidence Concerning Wild Maize in Mexico," *Journal of Heredity*, Vol. 21, 1930.

Madame Nuttall, however, was not solely an archæologist and historian. She was also an ardent horticulturist. She cultivated rare specimens of Mexican flora in the charming walled garden of her house in Coyoacan, the Casa Alvarado, a gem of Spanish Colonial architecture. It still is one of the show places of Mexico, and for years Madame Nuttall made it a center for the country's most distinguished visitors and residents.

A great historian, a great botanist, and a true intellectual, Zelia Nuttall lived a full and rich life. All of us who had the privilege of knowing her will regret the loss, not only of a rewarding friend, but also of a distinguished participant in the richer culture of a more gracious age than our own today.—G. C. V.

ISAAC WYMAN DRUMMOND

WITH the death on April 15th of Dr. I. Wyman Drummond, research associate in antique jade and amber, in the American Museum, there has passed from the life of New York City a personality of great dignity and distinction.

Doctor Drummond was born in Roxbury, Massachusetts, on June 19, 1855. He was educated at Columbia School of Mines in the early and what some would call the "Golden Age" of that great school. Under such a famous master in science as the late Charles F. Chandler, he specialized in chemistry, taking his doctorate in 1879. In those times students were in much closer touch with their educational leaders than are those of later generations, and Doctor Drummond was one of the last to hold vivid memories of this great Columbia chemist.

Upon leaving Columbia he became connected in a professional capacity with the firm of Davoe and Reynolds, manufacturers of paints, as consulting chemist, and later as vice-president and chairman of the Board of Directors.

The interest in minerals which he carried with him from Columbia, early led him to collect examples of Chinese carved jade and amber, of which he possessed at the time of his death a very notable collection. His knowledge regarding these objects was very considerable, recognized as it was by such an eminent authority as Dr. Berthold Laufer of the Field Museum, with whom Doctor Drummond was in close touch.

The interest which he took in the American Museum prompted him to present many fine pieces from his collection to the Morgan Gem Collection. These gifts are now on display in the two specially designed cases toward the middle of the Morgan Hall. His interest in the carving of stones, amber, and ivory, by Chinese and Japanese artists led him to connect himself with organizations for the development of art. Thus he was treasurer of the National Sculpture Society, and vice-president of the School of Applied Design for Women. He was also a member of the American Chemical Society, the Society of Chemical Industry, and a Fellow of the American Association for the Advancement of Science. Doctor Drummond was unmarried and is survived by a sister, Mrs. William Herbert.—H. P. W.

WILLIAM HENRY HOLMES

WILLIAM HENRY HOLMES, one of the founders of modern anthropological research, died on April 20 at the age of 86 years. Beginning as an instructor of physical geography at MacNeely Normal College in 1871, his interests turned gradually away from geology to anthropology during his service with the United States Geological Survey from 1872 to 1888. He was

archaeologist for the newly-formed Bureau of American Ethnology until 1894, when he became curator of the department of anthropology at the Field Museum and professor of anthropic geology at the University of Chicago. In 1897 he re-

entered the Government service, holding the posts of head curator of anthropology in the National Museum 1897-1902, chief of the Bureau of Ethnology 1902-1910, and head curator of anthropology in the Museum, 1910-1920. He was curator of the National Art Gallery from 1908-1920 and director until his death.

His influence on anthropological and especially archaeological research in America was enormous, and his publications, even after the lapse of many years, are fundamental source material. To choose his most important works from the two hundred publications on science and art he produced in his long life of research is well-nigh impossible.



ISAAC WYMAN DRUMMOND
1855-1933

Late research associate in antique jade and amber on the staff of the American Museum

However, the "Pottery of the Ancient Pueblos" (Bureau of American Ethnology, 4th Annual Report, 1886), "Archaeological Studies Among the Ancient Cities of Mexico" (Field Columbian Museum, Anthropological Series, Vol. 1, 1895-1897), "Aboriginal Pottery of the Eastern United States" (Bureau of American Ethnology, 20th Annual Report, 1903) and the "Handbook of Aboriginal American Antiquities" Part I, the Lithic Industries (Bureau of American Ethnology, Bulletin 60, 1919), are among the most important of his contributions.

Doctor Holmes was as celebrated a draughtsman as he was a student. He illustrated his own papers, and not even modern photography can improve on his remarkable drawings, at their best perhaps in his *Studies Among the Ancient Cities of Mexico*. He was also a water color painter of considerable note.

Doctor Holmes may well serve as an ideal for the students of today. His death has created a gap impossible to fill, but he is among the few

whose work is as significant in death as it was in life.—G. C. V.

THE LIBRARY

THE following new items of interest have been received in the American Museum Library: *Les Ars Anciens d'Amérique au Musée Archéologique de Madrid*. By Henri A. Lavachery. Anvers, (1929). 4to.

The author's aim in publishing this work was to make available for students of prehistoric America some of the outstanding pieces in the Madrid collection. He has done this by the use of fifty-one fine full-page reproductions, each of which is accompanied by a detailed description. The volume includes material from the Northwest Coast, the Antilles, Mexico, Central and South America.

Megalithic Remains in South-Sumatra. By Dr. A. N. J. Th. à Th. van der Hoop. Zutphen, Nederland, n.d. (1933). 4to.

This valuable contribution, translated into English by William Shirlaw, deals with the stone images found between Telok Betong in the south and the frontier of Djambi in the north, with special emphasis on the neighborhood of Pageralaam. It is beautifully illustrated and has a number of useful maps. The scientific organizations which have sponsored its publication are to be congratulated upon their undertaking and our thanks are due to the Provincial Society of Arts and Sciences at Utrecht for making it available here.

The Race Biology of the Swedish Lapps. Part I. General Survey. Prehistory, Demography. Future of the Lapps. With the Collaboration of the Staff of the Institute and of Professor K. B. Wiklund. Edited by H. Lundborg and S. Wahlund. Uppsala, 1932. 4to.

With the threatened disappearance of the Lapps as an ethnic group, this comprehensive work is to be particularly welcomed by the world of science. Through the meticulously kept clerical and parish records of the Swedish clergy, a wealth of material for researches is at hand which is unsurpassed and inestimable in its completeness and reliability even where the nomadic Lapps are concerned. This material has been assembled and worked over by specialists in the respective fields and the volume is rich in statistical tables. It has a number of fine text illustrations. The publishers, the Swedish Institute for Race Biology, are planning a second volume, dealing with the Anthropology of the Lapps, and it is to be hoped that this may appear in the near future.

The Western Pony. Written and illustrated by William R. Leigh. New York, 1933. 4to.

Mr. Leigh, by his life-long and close observations of the horse, has gathered a store of interesting data whose value is enhanced by a number of fine illustrations, six of which are full-page color reproductions of his paintings. A review of this work appeared in the May-June, issue of NATURAL HISTORY.

DURING April and May the following *Bulletins* and *Novitates* were published by the American Museum:

NOVITATES

- No. 606. The Relationships of Some Common Amphibia as Determined by Serological Study. By Alan Boyden and G. K. Noble.
- No. 607. A Pug-Headed Grunt, *Haemulon Plumieri*. By E. W. Gudger.
- No. 608. Structure and Affinities of *Trigonostylops*. By George Gaylord Simpson.
- No. 609. Birds Collected During the Whitney South Sea Expedition. XXIII. Two New Birds from Mieronesia. By Ernst Mayr.
- No. 610. The Development of the Urostyle in *Umbra Pugnax* (De Kay). By C. M. Breder, Jr.
- No. 611. Erycinidae and Lycaenidae (Lepidoptera, Rhopalocera), From the Regions of Mt. Roraima and Mt. Duida. By E. Irving Huntington.
- No. 612. Reproduction and Eggs of *Pomacentrus Leucoris* Gilbert. By C. M. Breder, Jr., and C. W. Coates.
- No. 613. A Round-Headed Silver Perch, *Bairdiella Chrysura*: With Notes on the Earliest Figured Round-Headed Fish. By E. W. Gudger.
- No. 614. The North American Species of *Actia* in the American Museum of Natural History. By C. H. Curran.
- No. 615. Records of African Bees. II. By T. D. A. Cockerell.
- No. 616. A New *Herbstiella* (Apoidea) from North America. By Charles H. Hicks.
- No. 617. Description of a New North American Species of *Lasia* (Diptera, Cyrtidae). By J. Bequaert.
- No. 618. Six New Eastern South American Fishes Examined in The American Museum of Natural History. By T. L. Marini, J. T. Nichols and F. R. LaMonte.
- No. 619. Experiments on the Brooding Habits of the Lizards *Eumeces* and *Ophisaurus*. By G. K. Noble and E. R. Mason.
- No. 620. A Study of the Green Pit-Vipers of Southeastern Asia and Malaysia, Commonly Identified as *Trimeresurus Gramineus* (Shaw), with description of a New Species from Peninsular India. By Clifford H. Pope and Sarah H. Pope.
- No. 621. The Skull and Mandible of *Conohyus*, a Primitive Suid from the Siwalik Beds of India. By Edwin H. Colbert.
- No. 622. Braincasts of *Phenacodus*, *Notostylops*, and *Rhyphodon*. By George Gaylord Simpson.
- No. 623. A New Crocodilian from the *Notostylops* Beds of Patagonia. By George Gaylord Simpson.
- No. 624. Some Neotropical Anthidiinae: *Anthidium*, *Heteranthidium*, and *Dianthidium*. By Herbert F. Schwarz.
- No. 625. Some Neotropical Anthidiinae: *Paranthidium*, *Anthidium*, and *Hypanthidium*. By Herbert F. Schwarz.
- No. 626. A New Catfish, *Amphilium Pictus*, and a Discussion of a Small Liberian Collection of Fishes. By J. T. Nichols and F. R. LaMonte.
- No. 627. A List of the Fossil Land Mammals of Japan and Korea with Descriptions of New Eocene Forms from Korea. By Shigeyasu Tokunaga.

BULLETIN

Vol. LXVII Art. 1. A New Fossil Snake from the *Notostylops* Beds of Patagonia. By George Gaylord Simpson.

ANTHROPOLOGICAL PAPERS

Vol. XXXIII Part 2. The Yakut. By Waldemar Jochelson.



NEW PUBLICATIONS

Jungle Bees and Wasps. Barro Colorado Island.
(With Notes on Other Insects). By Phil Rau, 324 pages
and more than 100 illustrations in the text. Published
by Phil Rau, Kirkwood, St. Louis Co., Missouri.

BARRO COLORADO ISLAND, the station of the Institute for Research in Tropical America, has been visited by scores of naturalists, and several books as well as a great number of scientific papers have been published regarding its fauna and its flora. Yet such is the diversity of forms that occurs within its area of 3840 acres that only a very few of the more than fifty species of bees and wasps whose life histories Mr. Rau presents in whole or in part, have hitherto been referred to in the literature regarding the island. His book is, therefore, a very welcome contribution. The layman to whom the term "bee" conjures up perhaps only the image of the domestic honey bee or the bumble bee (of which, incidentally, there are several hundred species and subspecies the world over) may learn with surprise that neither of these bees is represented on the island. Their place is taken, however, by a tropical group known as the stingless bees, for in them the weapon of defense usually associated with bees and wasps is vestigial. These bees live in nests very different in construction from those of our hive bee or of our bumble bees, and a fascinating opening chapter in Mr. Rau's book tells of the communal life and habits as well as of the nest structure of a number of different species of these bees.

Several chapters devoted to the social wasps follow. These chapters particularly are indicative of the industry and devotion with which the author has explored his subject, for, though a tropical forest may be rich in insect life, it requires sharp eyes, and an enthusiastic persistence to locate so many different nests and to familiarize oneself with the behavior of their inmates. Interesting comparisons are drawn between the behavior of some of the tropical species and that of their near relatives of the north, frequently revealing adaptation to a different environment. The architecture varies from nest to nest—there are contrasts almost as great as those between the pyramid of Cheops, the Parthenon, and the cathedral of Notre Dame, and these contrasts are well indicated in the series of photographs that are scattered through the text. Equally striking are the nest structures and the diversified

behavior of the solitary wasps—those that do not live in colonies—to which a separate chapter is devoted.

Although primarily concerned with bees and wasps, there are brief notes also on other insects and on spiders, and there is a detailed chapter on our northern carpenter bee, *Xylocopa virginica*, included because it belongs to a genus mainly tropical in distribution. In this chapter the author alludes to the egg of this bee as being one-half an inch in length, which is approximately half the length of the mother. This size relationship is even more astounding than that reported by Doctor Brauns in the case of a South African bee of the genus *Allodape*, in which the egg is one-third of the size of the laying female. A reading of Mr. Rau's text and an examination of his illustration make one wonder, however, whether something even more interesting than the laying of a gigantic egg has not occurred in this instance. May it not be that the supposed egg is a quiescent larva that has hatched within the mother, as is the case in some of the flies?

Mr. Rau reports several cases among the social wasps of the sting being barbed and becoming detached after the manner of the sting of the honey bee. This phenomenon is of even more general occurrence than is indicated by the instances he cites, and has been recorded in this magazine (Vol. XXIX, 1929, p. 424) in connection with the honey wasp *Nectarina lecheguana*.

In his notes on the solitary bees, Mr. Rau tells of an unidentified bee that nested in the shell of a land mollusk. In the Old World several species of Anthidiine bees and certain *Osmia* bees have the habit of using empty snail shells for the establishment of their nest. I have sought in vain among the shells of the land snails of Florida for evidences of a similar habit, yet through Mr. Rau's observations we have proof that the selection of such a nest site is not confined to the bees of the Old World. If I were to hazard a guess as to the occupant of Mr. Rau's shell, I should say it was possibly the recently described *Dianthidium currani*, an Anthidiine bee, of which the American Museum has a large series from Barro Colorado Island.

Instances like those above cited may serve to indicate how much there is in the present book to arouse the thought and interest of the reader—

and this applies even to instances when the reader is inclined to draw conclusions at variance with those of the author.

In an appendix to the volume Dr. Joseph Bequaert has described three new species of wasps belonging to the genus *Polybia* from the material collected by Mr. Rau.—H. F. SCHWARZ.

Educational Biology. By William H. Atwood and Elwood D. Heiss. Pp. xiii, 475, figs. 269. 2nd Ed. P. Blakiston's Son & Co., Phila., 1933.

THE teaching of biology has experienced a great change during the last decade. The beginning student is no longer required to dissect a grasshopper or to learn the parts of a crayfish. The principles course has gradually replaced the old type specimen method of instruction; or rather the beginning student is given a glimpse of all biology before he is asked to learn the details in any one branch. Atwood and Heiss have called their exposition of the essentials in a principles course *Educational Biology* and the treatment has been so successful that a second edition has just been published. Atwood and Heiss have not broken away entirely from the old scheme, for some of the principal types of animals and plants are considered in the first chapters. This is preceded by an introduction as to the nature of living matter and is followed by chapters on food and its relation to life, the perpetuation of life, variation and heredity, the improvement of life, the behavior of living things, human diseases and their control, evolution and the origin of man.—G. K. NOBLE.

The Three Kingdoms of Indo-China. By Harold J. Coolidge, Jr. and Theodore Roosevelt. Thomas Y. Crowell Co., New York, 1933.

TUCKED away in one of the capacious pockets of Asia the northern section of Indo-China has been neglected both by travelers and scientists. This book, therefore, descriptive of a

collecting trip in northwestern Indo-China and of a hunting expedition in the jungle country near Saigon in the south, is of enhanced interest. Officially, the combined forces were known as the Kelley-Roosevelts Expedition of the Field Museum.

The itinerary of the northern party, led by Harold J. Coolidge, Jr., included Lao Kay, Lai Chau, Phong Saly, Hatsa, and Luang Prabang. To penetrate into these mountainous and remote districts it was necessary to travel by boat, on horse, and afoot. The river journeys were by far the most exciting, involving constant danger and alert skill. The first part of this book, written by Doctor Coolidge, is a straightforward narrative of the routine of bird and mammal collecting, the hazards and discomforts of travel, and the minor occurrences incident to an expedition. The only mar to an otherwise successful trip was the death by fever of Russell W. Hendee, a member of the party, to whom Doctor Coolidge pays a sincere tribute.

The southern party, composed of Theodore Roosevelt and Suydam Cutting, had as its principal task the hunting of water buffalo, sledang, and banting, for habitat groups in the Field Museum. Previous to their arrival in Indo-China, Roosevelt and Cutting had spent five months in southwestern China where they had obtained a specimen of the giant panda. The vexations experienced in trailing the water buffalo are so graphically detailed by Mr. Roosevelt that one cannot but feel relieved when success crowned his efforts.

An appendix by Doctor Coolidge completes the book. He offers here a cursory account of the native tribes with whom he came in contact. Unfortunately in so brief a space he is able to do no more than whet the appetite of the ethnologist.—H. L. S.

NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum:

Sustaining Member

Honorable DWIGHT F. DAVIS.

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Mesdames JAMES W. ALKER, O. S. BREWER, ARTEMUS L. GATES, ARTHUR L. KERRIGAN, JOHN S. MAEDER, JAMES SHIELDS THOMPSON.

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The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor



A. KATHERINE BERGER
Associate Editor

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Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York, N. Y.

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Photograph by Alfred M. Bailey

THE "BEAR" AT DEMARCATION POINT

The farthest east in Arctic Alaskan waters for coast guard boats was reached when the "Bear" dropped anchor among the ice floes off the international boundary line near Demarcation Point on August 15, 1922

(See "A Cruise of the Bear," Page 497)

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DIVING IN CORAL GARDENS

A Scientist Works Beneath the Clear Waters of the Coral Reefs of the Bahamas

By ROY WALDO MINER

Curator, Living Invertebrates, American Museum

After ten years of work on the great Coral Reef Group which is now approaching completion in the Hall of Ocean Life in the American Museum of Natural History, Doctor Miner, the author of this article, took his fifth expedition to the Bahaman coral reefs in order to make another underwater study and to compare the artificially colored corals that will be used in the group with the natural coral growths. This article describes the work accomplished during the time spent in Bahaman waters by this latest of American Museum submarine expeditions.—THE EDITORS.

THE steady hum of the engine of the "Standard J." ceased as the bow anchor went overboard.

"Hey there, you Moxie!" shouted Captain Joe Bethell, "Haul up that dinghy! You and Sweeting carry out the other anchor and hook it over that coral in the yellow patch! Hustle 'er out now!"

Soon the graceful launch was floating close to the reef, anchored securely fore and aft. The brass rope ladder splashed into the water from the starboard gangway and I was standing on it submerged to my neck. Sweeting started one of the pumps going while Moxie carefully lowered the helmet over my head. I thrust my right arm through the loop of the air-hose.

The steady clinkety-clank of the pump sounded close to my ear as I adjusted the weight of the helmet to my shoulders and started down the ladder. The edge of the water-surface appeared momentarily through the window of the helmet and vanished upward as I passed beneath it.

Immediately the weight was lifted from my shoulders and the helmet seemed as light as a feather. I counted the rungs of the ladder as I descended, marking the number of feet from the surface. I swallowed once or twice to relieve the increasing pressure on my ear-drums, and at the twenty-second rung stepped off the ladder on to the white sand of the seabottom. A huge, black sting-ray rose from almost under my feet and swam slowly off with graceful undulations. I had missed him by inches!

Steadying myself by grasping a ladder-rung, I looked about me. A short distance away rose the coral reef, tier on tier, to the surface. Clusters of mushroom-like coral growths capped with gray-green and pink *Orbicella* formed the bulk of the reef. Purple and yellow sea-fans swayed back and forth with the motion of the water, while sea-bushes of soft and varied hue rose from slender stocks, their waving branches, extending upward in widely expanding parallel ranks, starred with



AN UNDERWATER PARADISE IN AN ANDROS CHANNEL

A bluehead swims out into a sunlit submarine valley, its gay uniform of blue, green, black, and white, in vivid contrast to the soft colors of a bank of *Porites* finger corals, tinted with yellow, pink, and violet

hosts of feathery polyps. Caverns and arches of eroded coral, fantastic in form, showed clearly through the unbelievably transparent water or melted into the pearly blue liquid mist in the distance.

I took a few steps forward leaning against the push of the current, and glanced up to see the keel and underside of the launch bulking above my head with propeller and rudder looking very formidable from below. My air-hose floated coiling to the surface, while clouds of silvery bubbles, released momentarily from my shoulders, rose in expanding clouds. A disturbance of the water at the summit of the ladder attracted my atten-

tion. A pair of legs appeared weirdly on the rungs. The body was not visible, being concealed by the liquid mirror of the water surface. This was impenetrable to the view, but reflected an inverted image of the legs, giving the odd effect of a St. Andrew's cross! In a few minutes the rest of the figure and a helmeted head succeeded the legs, descended the ladder, and stood on the sea floor beside me. Looking through the window of the helmet, I perceived the smiling features of Roswell Miller, who, with Mrs. Miller and my artist, Chris Olsen, completed the personnel of my expedition for the American Museum of Natural History.

I motioned toward the reef and we advanced slowly in the direction of an outlying brain-coral that towered above us on a fantastically carved pedestal, with a cloud of bright yellow fishes flitting around its summit like canary birds. Rounding this mass, we entered a crooked passageway which led toward one of the great overhanging arches of coral rock. As we peered within, a moving form became visible in the watery shadows, then another.

Presently, a huge parrot fish, brilliantly blue, varied with deep violet, swam slowly out of the cavern, followed by two others in stately procession. Back and forth they sailed, staring toward us, occasionally nibbling at a bit of loose coral, portions of which they crushed with their white, parrot-like beaks, releasing powdery fragments which rose in clouds as they masticated them for the filmy nourishment they afforded. We signaled to each other and edged back toward the boat. The window of a water-glass penetrated the surface beside the bottom of a floating dinghy. We motioned with our arms, and the undersea tripod splashed down through the water to settle bottom side up at our feet, its legs extending upward from the square metal top. The heavy camera-box now came gliding down, hooked on the end of a cord. We slowly and painfully erected the tripod, carefully adjusting it in a favorable position. One must move with deliberation at the bottom of the sea. Attempts at rapid motion were futile and exhausting, but if we moved slowly, the water supported us in half floating fashion and we progressed easily with the effect of a slow-motion film. A little push with the foot and we glided over an obstruction to a considerable distance and settled down slowly and gently. After the tripod was erected satisfactorily, we returned for the camera-box. I reached for it but miscalculated the distance, and my hand

grasped empty water about two feet in advance of it. Distances under water are deceptive to the vision, because of the unaccustomed density. Groping forward, I felt the handle of the camera-box, and had no difficulty in lifting, with one extended hand, a weight that both hands could scarcely raise from the boat's deck, in the open air. We carried the box over to the tripod, placed it in position, and took turns pressing the lever that actuated the mechanism of the camera. Unfortunately, by this time the parrot fishes had disappeared, though swarms of blue-heads and schools of jacks swam into focus.

As the focus of the camera had to be set at a predetermined distance before sending it down, it was impossible to focus on a fish directly, and it was tantalizing to see beautiful queen triggers, blue angel fishes, and grotesque trumpet fishes come into plain view at a distance of twenty-five feet, when we had carefully arranged our focus at ten feet.

After fifty feet of motion picture film had been taken, we carried the box back to the cord which hung suspended from the launch and sent it up for Captain Bethell to rewind and return to us again. When the film had completely run out, it was sent up for Mrs. Miller to change, and a second undersea box containing color film was sent down. This was Roswell Miller's specialty, and through its means he obtained beautiful motion pictures depicting the soft colors of the living corals and gorgonians and the brilliant hues of the fishes which lived among them. After a time, Chris Olsen took his turn with the helmet, and we worked our way carefully through the tortuous aisles of this undersea fairyland to observe more intimately the multitudinous variety of the creatures composing the closely interlocked association of forms characteristic of the living coral reef.

Our attention was attracted by a



COLLECTING "HONEY-COMB" ROCK ON SPRUCE CAY

Many of the smaller cays of the Bahamas are composed of eroded limestone rock honey-combed with cavities and winding passages of fantastic form, resembling a petrified sponge

SCOUTING FOR A FAVORABLE LOCATION TO DIVE

Members of the expedition using water-glasses to examine the sea-bottom for an advantageous position from which to study and photograph the coral reefs from the sea-floor





THE "STANDARD J." THE
FLOATING HEADQUARTERS
OF THE EXPEDITION

This forty-eight-foot gasoline launch, commanded by Captain Joe Bethell of Nassau, is well adapted for coral reef work. She has been used by Doctor Miner on two expeditions to obtain the material and observations for the American Museum's Coral Reef Group



ROSWELL MILLER AND
HIS UNDERSEA COLOR
CAMERA

The brass water-tight box contains a motion-picture camera adapted for Kodacolor. Mr. Miller succeeded in obtaining submarine color films of great beauty

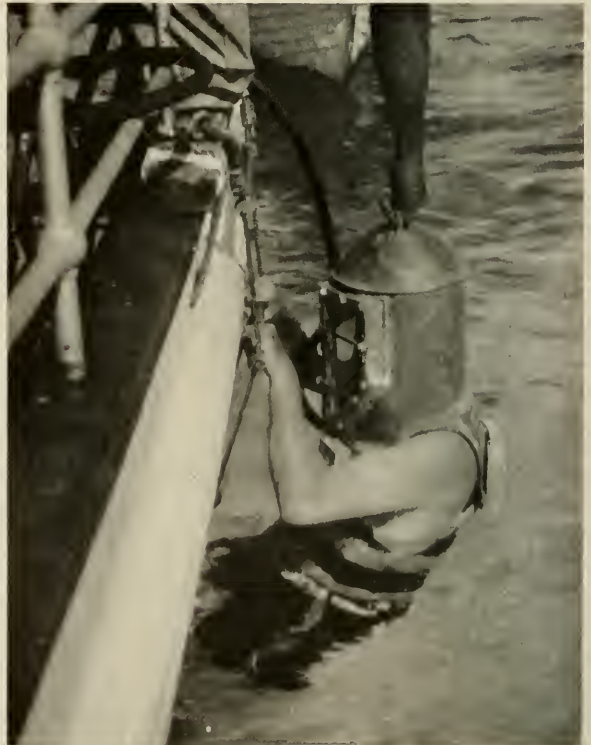


MRS. ROSWELL MILLER DESCENDS
BENEATH THE SURFACE

The heavily weighted helmet is being lowered over her head as she prepares to submerge

ridges exquisitely wrought with radiating star-shaped calices. Hues of delicate rosy pink shaded into cream-yellow tints, suffused at intervals with areas of orange and purple. We had brought with us specimens of this coral which had been colored artificially by our artists for use in the Coral Reef Group being constructed in the American Museum. We now took these with us down under the sea, and placed them beside the living specimens for comparison so as to test the accuracy of our colors. The result was very gratifying. At arm's length, they looked exactly like the real coral and blended with their living

wonderful cluster of golden yellow *Porites* coral which rose in an enormous dome above our heads. It was composed of a succession of expanded mushroom-like caps, completely covered with small conical mounds which gleamed in the sunlight flickering through the ripples overhead. Like most such growths, the caps were supported by eroded columns of dead coral limestone overgrown with encrusting sponges of scarlet, or green and yellow. Clusters of *Agaricia* coral grew vertically from the sides of the columns, sculptured on both sides of their thin leaf-like expansions with close-set series of fine parallel



DOCTOR MINER ABOUT TO DIVE

He stands on a rope ladder while the helmet is being adjusted. The rungs of the ladder are a foot apart, enabling him to measure his depth as he descends

neighbors so perfectly that they could not be told apart!

As we stood looking at the coral, we suddenly became aware of a beautiful sight. From the open ends of a cluster of little whitish tubes, soft tufts, for all the world like penciled color brushes, came into view, slowly unfolding until flower-like heads of violet and purple spread themselves wide open from every tiny aperture. Even while this transformation was taking place, another cluster began to expand, and then another, until the dead and eroded rocky shafts of coral became alive with the bursting bloom of animal flowers. For these were the heads of beautiful sabellid sea-worms which are crowned with circlets of delicate petal-like breathing organs expanding to receive through their thin, translucent walls life-giving oxygen from the watery flood in which they are bathed.

One stands amazed at the wealth of detail which gradually dawns upon the vision as the attention is directed to the multitudinous forms of which the reef is composed. Here, a magnificent purple sea-bush spreads its comblike fronds before us. Every branch is covered with thousands of transparent cream-colored polyps each spreading eight raylike tentacles around a tiny dot of a mouth, so small that it can be seen only upon close examination. The sunlight shining through their translucent crowded bodies outlines every twig of their waving,



MANNING THE PUMPS ABOARD THE "STANDARD J." Moxie, in the center, acts as tender. It is his duty to watch the divers and to pay out and take in the air-hose as needed

treelike home with a multiple margin of glory.

A cluster of fluffy green clubs rises from a crevice between two rounded brain-corals. The starry blanket covering them seems to be very soft and deep. I touched it with a speculative finger. The soft clubs magically transformed themselves into a cluster of hard, finger-shaped projections of bright purple! Looking closely, I saw that the fingers were covered with thousands of pinholes, and, as I watched, one filmy form after another peered forth and gradually elongated until the purple surface of the fingers became clothed once more with fluffy green.



TWENTY-FIVE FEET
BELOW THE SEA SURFACE
The motion-picture camera is
enclosed in a water-tight box
and is actuated by a lever
from the outside

structure except that their cylindrical polyps are surmounted by many tentacles in multiples of six, and have the power of laying down a skeletal structure of carbonate of lime beneath and around their soft bodies. The concerted action of millions of coral polyps builds

The sea-clubs, sea-bushes, sea-whips, sea-feathers, and sea-fans are all grouped together by scientists under the name, *Gorgonia*. Unlike the corals, their tree-like skeletal support is flexible, being composed of a tough, horny substance invested with a crust of felted calcareous needles, irregularly shaped and of extremely small size. A labyrinth of canals penetrates this crust, opening frequently to the outside by means of circular or oval apertures about the size of a pinhole. The living substance of the polyps is tubular and invests the canals throughout, projecting through the pinholes, when expanded, as tiny tube-shaped creatures crowned by a circlet of eight threadlike tentacles surrounding the central mouth-opening. If touched, they contract and withdraw into their hollow retreats.

The reef-forming corals resemble the gorgonian polyps in appearance and

up the immense and complicated limestone structures which form the coral reef. The coral skeletons may form crusts over the sea bottom, or may rise in dome-shaped masses like the brain and star corals (*Mæandra* and *Siderastræa*), or postlike growths capped like mushrooms, as in the case of the orb corals (*Orbicella*). They may be leaf-shaped, as in *Agaricia*, or like rosettes, or sinuously petalled flower-like colonies, characteristic of *Isophyllia* and *Mussa*. Among the most beautiful and striking corals of the Bahaman reefs are three species of *Acropora*, which forms branching structures, the most delicate and fragile of which is the fan coral



DOCTOR MINER FOUR
FATHOMS BELOW
THE SURFACE

His sixty-five-pound helmet rests lightly on his shoulders, because of the supporting power of the sea water

(*Acropora prolifera*). The staghorn coral (*Acropora cervicornis*) builds loosely branching many-tined skeletons reminding one of the antlers of a stag, from which its name is derived. The largest and most massive of the three is the great elkhorn, or palmate coral (*Acropora palmata*) which forms gigantic growths with branches like beams, expanding into broad, palmate tips, reminding one of the antlers of an elk. This species dominates the great Andros barrier reef, where the scene of the American Museum's Coral Reef Group is laid. All the other species of coral are found there, but are overshadowed by the great orchard-like groves of the elkhorn, which rise in tangled thickets of marble trees tinted with saffron.

Of the five expeditions I have led to obtain the material and observations for the Coral Reef Group, the first three centered around the Andros reef. The two latest, including that of the present year, concentrated on the beautiful reefs of Rose Island. Here, again, all the species characteristic of Andros are present, but the elkhorn coral is relatively rare, while the dome-shaped corals and the gorgonians are particularly abundant. The Rose Island reefs thus form a strongly contrasting association as compared with the Andros Barrier Reef. The latter is massive, wild, and grotesquely beautiful in its effect, as the coral growths run riot in protean variety and menacing grandeur.



COMING TO THE SURFACE AFTER A DIVE
Moxie reaches down to remove the helmet as the head of the diver appears above the water

The Rose Island reefs, on the other hand, are filled with soft and colorful beauties, due to the rising terraces of rounded species, cap beyond cap, dome beyond dome, their foundations columned and buttressed, pierced by caverns, arches, and winding passages. Their ethereal beauty is heightened by the multitude of waving gorgonians; sea-plumes, sea-feathers, and sea-bushes of many soft and varied hues—purple, violet, brown, tan, yellow, and lavender—waving back and forth in the sunlight which descends through the heavenly blue waters in beams of light. When the water surface is roughened, these sunbeams may be seen flickering and dancing



A PURPLE SEA-FAN WITH FULLY EXPANDED POLYPS
Waves back and forth in the sunlight glinting through the lacy openings of the delicate meshwork composing its flexible fan-shaped "skeleton"

up and down, piercing the water in shining spear-shafts, advancing and retreating like Northern Lights. Out from behind the clustered domes dart fishes of every brilliant hue, in almost every unbelievable contrast of pattern and color, while from coral arch and deep, dark cavern, the bulky, bright-colored parrot fishes, the huge, somber jew-fish, and the variegated and changeable Nassau grouper, peer and nose and glide in slow and stately parade. Now and then a great school of silver-blue jacks with clean-cut bodies and small-peduncled, slender-finned tails will glide across the view and even surround us completely. Hundreds of them! All glide by, swimming in the same direction, passing out of sight, their silvery-blue bodies suddenly vanishing in the silvery-blue haze of the undersea. Suddenly they appear again out of nowhere and sail past in the opposite direction. This will happen several times, as if

the entire school were formed into a committee of the whole to inquire into the doings of their strange, helmeted visitors from the upper world.

It is true that there are fish-serpents in this coral paradise of the fish world. Long and slinky

green or spotted morays with small serpent-like heads and sharp needle-like teeth lurk among deep crevices of coral. But they are seldom seen, and if we are careful not to thrust hand or foot into an unexplored hiding place, there is little danger. Once, a barracuda, more to be dreaded than sharks, swam over my head while I was engaged with a camera; but I didn't know it till I came to the surface, when Captain Joe told me about it. However, it did not disturb me and went about its business elsewhere. As for sharks, one is occasionally seen about the reef, but both sharks and barracudas are open-water fishes. They seem to need



GOLDEN YELLOW
PORITES CORALS

Like nuggets of gold, they are massed together in immense clusters, capping irregular columns of eroded limestone



A CORAL FOREST ON THE ANDROS REEF

Stone trees, fifteen feet in height, with closely interlacing branches, present weird undersea prospects, in striking contrast to the dome-shaped coral growths characteristic of the Rose Island reef

sea-room, and do not usually bother with the serrated entanglements of coral reefs. So, if one is careful about crevices, and watches not to step on a sting-ray, and keeps one's ankles away from the needle-like spines of "sea-eggs," as the natives ironically call the big black sea-urchin (*Centrechinus antillarum*), there is not much to fear, not nearly so much as there is in crossing Broadway during the rush hour.

Day after day, whenever the weather permitted, the good launch "Standard J." took us from clump to clump of the reefs at Rose Island, Athol Island, and Long Shoal. We had three undersea cameras, two for black and white motion pictures, and one for color film. The latter and one of the former were the ingenious contrivances of Roswell Miller. There were also two helmets and pumps, which thus enabled two persons to get under the sea at a time. We could walk

about together and converse simply, by means of predetermined signs which enabled us to compare notes for our work. At times Chris Olsen would go down with palette and easel constructed of non-corrosive metal. He would set up his easel on a convenient clump and fasten into it an oiled canvas securely mounted on a sheet of plate glass. Then he would actually make sketches with oil colors directly from nature, undersea, at a depth of fifteen or twenty feet. At first, he used the regulation artists' brushes with wooden handles, but whenever, inadvertently, he let go his hold on one, it would float to the surface and Moxie would have to row out with a dinghy to get it. Besides, in the wash of the tide, a brush is not steady enough for applying color. So Olsen finally used a palette knife instead, which was much easier to manage.

I succeeded in getting motion pictures



MANY-BRANCHED GORGONIAN SEA-BUSHES

Their vertical fingers, extending upward in closely parallel ranks, are covered with feathery white polyps, which outline the slender subdivisions like a halo of light as the sun shines through them



DETAIL OF A CORAL CLUSTER ON A ROSE ISLAND REEF

Huge dome-shaped masses of tawny or gray-green *Orbicella* corals, suffused with delicate pink, rise in towering clusters to the water surface, interspersed with patches of fluffy red and green algæ and branching gorgonia



NUMEROUS SPECIES OF GORGONIANS GROW AMONG THE CORALS

These are flexible coral trees each built up by thousands of tiny polyps, constructed by them of a horny substance, in contrast to the limestone "skeleton" built by stony coral polyps



CHRIS OLSEN PAINTING AT THE BOTTOM OF THE SEA

Equipped with diving helmet, monel metal palette and easel, the expeditionary artist made sketches of coral reefs twenty-five feet below the surface. He used oil-colors on an oiled canvas stretched over a sheet of glass



A GREAT ELK-HORN CORAL

High on the summit of the reef, close under the water surface. The spreading tips resemble the antlers of an elk

swam about the boat for long periods, looking down at Mr. Miller and myself as we worked, peering through a water-glass held in front of her.

At other times we had the pleasure of introducing His Excellency Sir Bede Clifford, the Governor of the Bahamas,

of him at work, by going down in another helmet for the purpose and mounting an undersea camera on the tripod at a carefully measured distance. An enlargement from a portion of one of these films is shown in this article.

Of course, it was possible to make only the preliminary sketches undersea. The finished studies were made at our headquarters in Nassau, where our studio was established at the hospitable home of Mr. Edward S. Toothe.

Mr. and Mrs. Roswell Miller were splendid coworkers on this trip. They are excellent swimmers and occasionally, while both helmets were in use, I would sense a splash above my head and look up to see a graceful, red-clad figure break through the mirrored water-film, and Mrs. Miller would come diving down in a stream of silvery bubbles, or we could see her partly penetrating the surface as she

and Lady Clifford to the undersea world. They came down in turn, and explored the face of the reef, working their way through the crevices between the coral clumps, facing the inevitable camera at a depth of twenty feet. The Bahaman officials were all greatly interested in our work, both in this and in all the previous expeditions, and did everything in their power to assist us.

- Occasionally, when the weather was too rough for diving, we went ashore on one of the rocky cays which abound in the waters near Nassau, and, by means of hammer and hatchet, hacked off huge fragments of the eroded "honeycomb



CORAL GROWTHS LIKE GIANT PETRIFIED MUSHROOMS

Rise above waving fronds of sea-fans and sea-bushes, melting into the luminous blue of the distant watery prospect

A SCHOOL OF SILVERY JACKS

They swam solemnly past the undersea workers, as if to examine the intruders into their submarine Paradise

rock" of which they are composed. This rock is wrought by wave and weather into most fantastic forms; in fact, the whole surface of the cays is full of holes and passages contorted and twisted and anastomosing like a petrified sponge. We obtained more than a ton



of this rock and shipped it to the Museum, where we are now reproducing a portion of such a rocky cay as a part of the foreground in the upper section of the group, using the original material in the process.

This group is now nearly finished. A few months more and the exhibit will be complete, after ten years of arduous work. During that time, five expeditions have been undertaken to the Bahamas, the first, in December, 1923, for preliminary observations and arrangements; the second, in 1924, secured forty tons of coral, many feet of undersea photographs and motion pictures of the Andros reef, and many water-color studies from

life, using the Williamson undersea tube and diving helmets for the purpose; the third, in 1926, obtained the casts and sketches of the fishes for the group, as well as sketches for the great cyclorama representing the scene of the coral lagoon above the water; the fourth, in 1930, procured the gorgonians needed, properly prepared, and additional undersea motion pictures and observations, utilizing diving helmets; the fifth, during the spring of the present year, also utilizing diving helmets, a check-up expedition, made final observations and additional motion pictures from the sea-bottom, and obtained rock for the coral island.



These five expeditions have been interpolated between long periods of work at the Museum, preparing and coloring corals, erecting the elaborate framework to support them in the group, consisting of more than seven tons of structural steel.

SIR BEDE CLIFFORD,
GOVERNOR OF THE
BAHAMAS

Inspecting the Rose Island gardens on the sea bottom. Governor and Lady Clifford were enthusiastic divers

modeling and coloring fishes and the other multitudinous forms of undersea life composing the coral reef association. The great upper and lower backgrounds had to be colored for this huge two-storied group which exhibits the above-water and under-water scene simultaneously. Eleven-foot plate-glass backgrounds had to be inserted and colored, and the under-water illusion

had to be worked out. Various items remain to be completed. When finished, it is estimated that the exhibit will be the equivalent of thirty ordinary Museum groups in size and difficulty of preparation. It will occupy one-third of the entire farther end of the great Hall of Ocean Life, probably the largest museum exhibition hall in the world.



LANDING THE "HONEY-COMB" ROCK
AT NASSAU

The expedition brought back more than a ton of this rock to build a rocky cay as a part of the Coral Reef Group in the American Museum

Camera Studies from India



A NATIVE OF NEPAL

A Series of Photographs Taken in Mysore and on
the Border of Nepal

BY
MRS. HERMAN CRON



IN THE UNITED PROVINCE

It is commonly true in India that the native cattle are permitted to roam about almost at will. Note the stacks of hay on platforms out of their reach



A MYSORE PARENT

Since the advent of the British in India, infant mortality has dropped enormously



IN MYSORE

Mrs. Cron among a group of her photographic subjects in Mysore. The heterogeneity of this group in stature, hair form, and other physical traits is especially interesting



A CAMP ATTENDANT

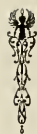
The negroid influence of the south of India is reflected in the hair of this man from Mysore. In northern India the natives generally have straight hair



FROM THE
FOOTHILLS OF
NORTHEASTERN
INDIA

Note the contrast between these peoples and those in the preceding pictures. From this area some of India's most famous warriors have come





ADDITIONAL
TYPES FROM
NORTHEASTERN
INDIA

Two more representatives of Northeastern India. The Mongoloid influence is particularly clear in the young man pictured at the left



WOMEN OF MYSORE

The beauty of some of India's women is charmingly represented by the woman on the right

PRIMITIVE SPINNING

The spinning of thread is still done in primitive fashion in parts of India. This man's curiosity concerning the white visitors did not interfere with his occupation





A GRAYBEARD
FROM MYSORE

This ancient gentleman is decorated with ritualistic marks on his chest, arms, and forehead. They are put on with ashes



A YOUNG MOTHER

This girl from the border of Nepal wears a costume that is very different from the women from southern India pictured on the opposite page



REPRESENTATIVES FROM SOUTHERN INDIA

India has attracted, in the course of its long history, a succession of racial invasions. The results of this diverse origin of the present population are plainly visible in the physical types





Painter-Clark African Expedition
The Covered Ox-wagon Is Slow But Sure

EXPEDITIONS

Journeys Into Far Corners of the World Which Are Planned and Carried Out to Further Man's Knowledge.—The Fascination and Difficulties of Museum Field Work

By JAMES L. CLARK

Vice-Director (In Charge of Preparation and Exhibition), American Museum

IT must be the spirit of adventure coming down to us from roaming primitive man and still lingering in our blood that causes this word "Expedition" to be so alluring. At once it conjures in our thoughts jungles of tangled green, sandy deserts of prickly plants and broken rock, or grassy plains that roll on and on to far horizons.

Such fancies may even take us over billowy seas toward balmy tropical isles of nodding palms, or through virgin forests high up to stunted timber and rocky mountain ridges, where glaciers rest serene.

And so we may wander over the world in fancy, exploring here and there, wondering what's beyond, seeing dream pictures in our minds, and wishing perhaps that some day we could go.

"But how," we may say, "could I do it? Not being a hero or an athlete, I wonder if I could? What does one have to do? What does one have to know?"

It is largely a matter of gradually working into it. We who do go forth on expeditions are neither heroes nor athletes.

Everyone must take his *first* expedition sometime, and from this he gets his first experience. I well remember my first, the most glorious and thrilling of all, when, a small boy on a farm in Rhode Island, like Huckleberry Finn, I started out to see something of the world. Leaving the house, alone, I ventured forth to "explore" over the stone wall into the woods beyond. That was a great journey. I felt alone in the world—cut off completely. Yet I was but a good stone's throw from the kitchen door. How big

*Painter-Clark African Expedition*

ON SAFARI

In Africa, all expedition baggage was previously (and is sometimes now) carried on the heads of porters doing eighteen to twenty miles a day, and receiving ten or twelve cents. Now, where the country permits, automobiles have taken their place, saving long, hard, tiresome days for the expedition, which permits this time to be applied to constructive work

the world seemed—how silent the woods! How weird those mysteries beyond! I suspected bears and big, black wolves were waiting behind every tree, ready to jump out and get me, and if I'd gone a bit farther, perhaps Indians, too, might pounce upon me. At every step I looked behind to see if things were following, or if I knew my way back home.

I was cold and shivery each time I tip-toed and stopped by some friendly tree, while I looked around under this log and over that one, trying to catch sight of something moving.

And so today I have much the same weird feeling when I venture into unknown places. Now I can, superficially, at least, subdue my fear, but cannot altogether live it down. If one lost this entirely, I am sure he would lose much of the thrill that adventure holds.

So, like many others, I became an explorer, and each expedition has added to my bag of knowledge. There is no other

rule. It's just accumulated experience.

Expeditions are not aimless pleasure jaunts, to get what you may, although they often read as such, but are, instead, carefully planned trips with definite purposes and objectives.

There are but three ways to become a member of an expedition. The first and surest is to have money to contribute to its financing. Second, to have definite knowledge of some branch of science to be covered by the expedition's field work; and third, to make trips on your own until you build up experience which may qualify you sufficiently to join one later on, or continue to carry on by yourself and organize your own.

Expeditions are necessarily expensive, depending, of course, on the country to be traveled, the scope and nature of the work to be accomplished and the necessary personnel. Finances may be provided by institutions desiring to have certain field work carried on, by individuals particu-

larly interested in phases of science, or by an individual conceiving a plan sufficiently worth while to recruit private support.

One may only be considered qualified to lead an expedition by reason of his past experiences, his knowledge of the subject, and his ability to handle and lead men. He may be chosen on these qualifications, or, if organizing it himself, he is self-appointed, but his success in raising the money depends on his reputation and his salesmanship.

These privately promoted expeditions are sometimes worth while, but many are wild-cat schemes, financial coups, which, if they do get started, often result in glorious failures.

Each expedition, unless repeated, is vastly different, and even the leader has much to learn as he proceeds over new ground. It is just here that his past experiences help him to anticipate and

meet new conditions.

The personnel is determined by the amount of money and the scope of the work. On this, individuals are carefully selected, so that each one may adequately cover certain phases of the work. They form the skeleton force for the field, where local people and transport are recruited to support their activities and movements. An expedition may consist of from one to five or ten, and in a few cases more, but experience teaches that the fewer there are, the better things work. It is very easy to get them "top-heavy," retarding mobility and increasing dissensions, which readily arise under trying conditions and long, constricted association.

A military campaign is the largest possible "expedition," and is always "top-heavy." A great staff of men is necessary, just to administer, care for,



Painter-Clark Expedition

CATCHING UP WITH THE NEWS

Camps in the tropics are often comfortable and quite complete. Accumulated mail and occasional papers from home, brought by runner, sometimes for more than a hundred miles, always break the monotony and make for a day of good cheer



Photograph by H. E. Anthony

SLOW PROGRESS

South America and other tropical, forested countries can be penetrated only by slow, laborious, and dangerous work up the rivers. Such expeditions must go very "light." Local native canoe men, expert in this mode of travel, furnish the man power, but always the white man has much to do to help himself along

feed, and transport an only slightly larger number of active field or fighting men. The whole organization is unwieldy, slow, and limited of movement.

As for women as explorers or as members of an expedition, I would say that there are exceptional women who can do many things as well as men. Such women could well fit into an expedition, doing certain work that they are qualified to do.

But the personnel must be "hand picked," as with any organization, and the more carefully its members are selected, the more successful will be the organization and the results.

Although men are physically stronger and generally temperamentally constituted to fit better into an expedition, there are a very great many who are not, and who cannot meet the trials of emergencies or take the punishment of long, hard hours of travel, which often must be done. There are women who can fit in well, meet emergencies as they come, and out-walk many men. These could carry on just as well, but often it is awkward for both to have one or two women mixed with a lot of men, and, in view of this, there usually can be found men who will do all that women can do and are physically stronger, to assist in much of the heavy and disagreeable work which often comes up.

Each woman in the party adds to the expense by separate quarters en route and separate tents

in the field, all of which is a factor when every effort must be made to hold down equipment and expense.

There is no good reason why a group of women could not, if carefully picked, carry on an expedition as well as men. Their limitations would be in physical strength and endurance and in their uncertain tendencies toward full coöperation in team work.

Even though expense may be secondary to the success of the expedition, a superabundance of equipment is ever a handicap. It increases transportation problems in the field and retards mobility,

which in turn slows down the vital field work.

Equipment is entirely governed by the country to be traveled, the mode of travel, the seasons to be encountered, and the duration of the trip. There is much in the modern sporting-goods store that adds to the comfort of the explorer—light tents, warm, light sleeping-bags, concentrated food, and a lot of little things which save much time, as well as bring comfort.

Time is always a factor in the field. Every minute must be applied to the work to be accomplished, so the leader tries to organize with this in view. Seasons you are to pass through govern also what you take, but it's a good rule to take the minimum. The beginner loads up with everything he thinks he might need, and nearly sinks the ship

with bag and baggage as he leaves New York, only to find himself wishing he'd left more than half of it back in the stores and saved the money. But he must learn, and next time he takes much less, but again all too much. People live all over the world, and they have in their stores what is best for that country, so you can always obtain enough to get on with, both as to food and clothes and much of your equipment. True, if you are to do special work, you need special equipment and materials, and it is here the experienced man gives his most thought.

As the leader is responsible for the lives and welfare of his men, their continued good health is his first consideration—not that he takes great cases of medicine along for his staff, but he does take a few simple things like quinine, iodine, etc., all contained in a small first-aid kit. Going



Photograph by H. E. Anthony

NATIVE CARRIERS

At times, when there are but few or perhaps no natives in a country, the expedition man must pitch in and do his own carrying. It is then he goes the lightest, and eliminates every non-essential, often living off the country. Here his experience and woodcraft serve him well, and permit him to adjust himself to things as he finds them. He who can do this for a period of time is a real explorer



Morden-Clark Asiatic Expedition in Chinese Turkestan

WAGON CARRIERS

Small wagons are next best to automobiles. They carry a lot and make good time. Only where there is level country, horse-feed, and water to support them, are such conveyances available. With these, 150 miles have been covered in three days



Morden-Clark Asiatic Expedition

YAK TRANSPORT

Beats of burden save many men, and are used wherever it is possible to obtain them. Changing transportation every day or two absorbs much time and makes progress slow. A contract price per day is made with the man for himself and beast



Morden-Clark Asiatic Expedition in the Thian Shan Mountains

AT A FORD

In the mountainous country of the temperate zones, where grass supports the horse, the pack-train is the one best method of transportation. With them an expedition can penetrate rugged and otherwise forbidding lands, but much time is consumed in making and breaking camp



Morden-Clark Asiatic Expedition in the Himalayas

BREAKING SNOWTRAILS

In mountainous countries of no roads, local natives must pack in every bit of expedition material. Usually they travel to the confines of their own district, where new men must be recruited. Twelve to fifteen miles is a good day's trek



Carlisle-Clark African Expedition

into the field is going into physical training. You are in the open. You work hard, and are to bed early after a hard day, with a good night's sleep, so you are soon in fit shape and need no medicine.

If transportation will permit carrying them, you sleep on cots, with blankets, bed-rolls, and mosquito nets. It is well to sleep off the ground in tropical countries, as it is cooler and you are freer from insects. Hammocks are often used, if going light. In cold countries, it's warmer to sleep on the ground.

In north countries you may wash and bathe in streams, but in the tropics you usually carry folding canvas baths and basins. However, baths are not an

LOADED TO THE BRIM

A fleet of sturdy cars jump the great spaces of the Gobi in the summer season. They can penetrate far into the back country only when supported by a great caravan of camels, which starts out months ahead, carrying gasoline, food, and supplies. The camels then bring in tons of fossils that could not possibly be transported in the cars, which are used only for dashing in and out and for reconnaissance work in the field

ROMANCE LOST, BUT EFFICIENCY GAINED

Where conditions permit, automobiles are used. Fifty to 150 miles a day can be made, depending upon the country. Such units are quite self-contained, carrying water, gasoline, food, and equipment. Waterless or far distant areas, otherwise barriers to progress, may thus be penetrated and investigated. It is in such new areas that the scientist often finds his most fruitful field

essential to good health, and you get them when time and water permit.

Invariably, your food is good and whole-

some, prepared by native cooks hired for the trip at your starting point. Even if it be only plain native food, you can live on it if it is well cooked, and, after all, it is usually for a limited time. Canned goods, although heavy, are invariably taken for emergency use, and in case you do get bad fare here or there, they break the monotony of the daily routine and help to satisfy a craving for something different. Napoleon said, "An army travels on its stomach," and this is true of expeditions. Good food and a good night's rest will do much to



Third Asiatic Expedition

© *N. Y. Times and St. Louis Post Dispatch**Byrd Antarctic Expedition*

THE AIRPLANE, LIKE THE AUTOMOBILE, HAS REVOLUTIONIZED EXPLORATION

It has made possible important survey work and accomplishments otherwise next to impossible, except by a great expenditure of time and money. The airplane must, however, always operate from a well-organized base, and its prime purpose is in its reconnoitering work and in jumping great spaces, to lay down men and supplies over a country otherwise impassable or exceedingly long and laborious of accomplishment

keep one fit for continued hard work.

One's greatest danger lies in the drinking of contaminated water, and this you watch carefully, boiling it when in doubt. As for sickness or accidents, you just take your chance on these and trust to luck. But you are really less in danger of sickness and accidents when in the field than you are at home, among multitudes of people and myriads of automobiles. Naturally, before you leave, you see the doctor for a "once-over" and vaccination and inoculation of typhoid, and have your dentist put your teeth in order. With these precautions, a passport, and a letter of credit, you're good for a long stay from home in almost any land.

All heavy equipment should be so designed that it may be divided into light units of not more than fifty pounds. It is always a good rule to pack everything into boxes or bundles, which can be handled or carried by one man. Then you never are stuck in an emergency. You can always

pick them up yourself, or pack them in units on camel, pack-horse, natives' backs, or in a canoe.

If you go by sailboat or steamer, using this as a "base camp," weight and size are secondary considerations, but the first rule is good, for you may have to trans-ship or change your plans to go ashore.

An oceanographic expedition is quite the ideal one. Here you have a steamer as "base camp," completely fitted out for your work. There is plenty of room for personnel and equipment, and you move about to new grounds, complete and in comfort.

Routine camp and transport work is done by local hired natives, who are under a chief or headman hired at the same time for this purpose. It is to him you give your orders and you hold him responsible for their execution. They are invariably good servants, and care for you well and take an interest in you—curious always as to what you are doing and why you are doing it.

*O'Donnell-Clark Expedition*

ON THE NILE

This great waterway is the only artery of transportation in Northeast Africa. A power steamer, with barges for fuel, men, and expedition equipment, form the base camp, while automobiles, carried also on the barge, serve as a means to tap the country back from the river, which is practically impossible for the white man to negotiate unless supported by such a moving river-base-camp

If you go "light," you must live off the country—buy native grains, vegetables, and fruit, and shoot game for meat. Such life is a matter of mental adjustment, and if you can adjust yourself to things as you find them, you can be healthy, happy, and accomplish a lot. This, too, is acquired from experience. Some individuals fuss and fume at food and cold and this and that, making themselves and everyone else unhappy. They should never have gone afield, and, probably, once back home, never will go again. They thought they'd like it, but, to the sorrow of all, found they didn't. So, it is a process of elimination. The able ones carry on; the unfitted drop out.

It's in a man's blood to want to go, and it's this same thing that carries him through difficulties when they arise. If he likes it, he never falters, and stands ready to do or die without a whimper.

Luck plays a large part in field work. Cut off from many helping hands, you're on your own. You may plan and work things out, being guided by the best information it is possible to get from natives or the last outpost, and then, when all should click, something happens. Weather turns dry and hot, drying up water holes you had counted on, or rain comes when it shouldn't, making the ground impassable for days, while most of your equipment gets either damp or wet, and tempers become ragged, while time is lost to upset your whole schedule.

There should, therefore, always be a margin of time allowed, but, alas, every day is crowded to the brim in your effort to accomplish other worth-while things which have presented themselves. Always hopeful of great achievements when you start, it is ever an effort to keep the whole expedition from being a complete

failure. Every one of the personnel has his particular branch of work to follow, but it takes constant and energetic effort to keep all this working as it should.

Expeditions are seldom pleasure trips, as people are prone to think, but really serious and often trying undertakings, and everyone is at a high tension trying to make good. There are periods of relaxation, when on long boat trips or train rides, but there is always something to be done—accounts to straighten out, cabling ahead for reservations and contacts, checking and repacking equipment, or reading up on the country to be visited. Nor are things as you expect to find them when you get there. It's raining when it should be dry. The officials you expected to see are away on an inspection trip, and delays pile on delays, while your

expense accounts keep running up like a taxi meter, and you see your already strained pocketbook getting thinner.

As supplies are reduced, specimens accumulate and are packed in boxes left empty. Often these are of much greater bulk and weight than the depleted supplies. If such is the case, relays of men and transport keep contact by long or short journeys with the nearest rail head, where your specimens are stored until you come out and arrange for their shipment home. Often you may find local merchants who will arrange this for you. Then you can go on, to come out at some other port.

All such conditions and problems must be anticipated and considered before you break contact with the last outpost. Otherwise you find yourself over-loaded for your return, and perhaps having to leave



Photograph by H. E. Anthony

THE "MORRISSEY" IN THE POLAR SEA

Expeditions using a boat are self-contained. They can get little food in the frozen North except some fish. Quarters are always crowded, but comfortable and warm. The season, however, is short, and much has to be accomplished under trying conditions and in limited time. Casks containing food are refilled with specimens

your valuable specimens behind forever.

Seldom is one completely out of contact with the world. Invariably, one can find "runners" who will make long journeys to the nearest post.

If transport is limited, your operating radius is reduced. Then you use all available transport to get you out to a "base camp," where, once established, you can free your transport to relay back and forth from rail head or outpost, taking in specimens and bringing out food.

It is not uncommon to operate in waterless areas, where water, too, must be relayed. This must be carefully organized, to insure a continuous supply, for man and beast can subsist but a few days without water, while they may live many without food.

It is always surprising to a leader, after months of hard work in the field, to come back and see how little he has obtained. He has worked long hours, often into the night, to secure his specimens and felt he was accomplishing wonders. When he unpacks them at home, his fine, big collections seem so insignificant. Yet it is all there, according to his list. Hardly can he believe that all the expenditure of time and toil and money has produced only that. He knows that there was not a minute lost, yet he

is almost discouraged. No one could have done more. His specimens are invaluable to science, and perhaps many of them entirely new to science. They cannot be judged by quantity, but by quality.

There is no way of getting them more cheaply. Someone who knows must go and get them, and this he has done. It is their careful preparation and preservation in the field that takes time. Infinite field notes, photographs, and records must be made, if their scientific value is to be enhanced.

It is impossible to measure the importance of expeditions to science and education. In fact, without them, there would be no science and education. All human knowledge is based on discovery. It was the wanderings of primitive man in search of food and shelter that led to the first beginnings of scientific observation and research. As these uncouth "explorers" of long ago sat around their fires and told of what they had seen in their chance journeys, they recorded the findings of our earliest expeditions. To-day it is not enough to wait for accidental discoveries. Journeys are made with intelligent purpose, deliberately planned and painstakingly carried out to achieve a knowledge and understanding of our world. Such journeys are our Expeditions.



Morden-Clark Asiatic Expedition

ON THE GOBI DESERT IN WINTER



The "Bear" in Emma Harbor, Eastern Siberia, in Mid-July

A CRUISE OF THE "BEAR"

Narrative of a Journey Along the Arctic Coast of Alaska

By ALFRED M. BAILEY

The Chicago Academy of Sciences

The photographs accompanying this article were made by the author (except as noted) while serving as leaders of the Arctic Expedition of the Colorado Museum of Natural History. He desires to express his indebtedness to Director J. D. Figgins and the Trustees of the Museum for permission to reproduce them.

—THE EDITORS

THE coast guard service has extended its activities into many waters and for years the names "Corwin" and "Bear" brought visions of sturdy vessels plying in the ice-filled waters of Bering Sea and the Arctic Ocean. Both vessels have long since been replaced by more modern ships, but those of us who have cruised along the rugged Alaskan shores will remember pleasant days with agreeable companions. The "Corwin" was in service in the late Seventies and Eighties, while the old "Bear" came later.

The "Bear" was a whaler purchased from the British for the Greeley relief expedition to accompany the "Alert" and the "Thetis." The discovery of the Greeley party was one of the notable events in arctic explorations, but prob-

ably caused no greater interest than during 1897 when so many whaling ships were crushed in the ice at Point Barrow. The experiences of the crew of the "Bear" have been written in history, but comparatively few of us remember the overland trip in winter of Lieutenants Jarvis and Bertholf, and the driving of the herds of reindeer from Cape Prince of Wales to Barrow, that the deer might be used as food for the stranded whalers.

There are many officers on the honor roll of the "Bear," and Captain C. A. Cochran was one of the most popular of the "ice captains" of Alaskan waters, for he made more than a score of cruises into the Arctic and was known to a generation of Eskimos. It had been my good fortune to make a cruise with Captain Cochran



KING ISLAND VILLAGE

"Cliff-dwelling" Eskimos live along the precipitous slopes of King Island, eighty miles off the Alaskan coast in Bering Sea. The hardy natives are skilled hunters of the sea mammals

on the "Thetis" in Hawaiian waters, and later, to accompany him on one of the last journeys of the "Bear" to the far north.

A half score of years have slipped by, but I still enjoy memories of the voyage.

For three weeks or so before we entered the Arctic Ocean, my companion, Russell W. Hendee, and I had been aboard the "Bear" which, in that time had visited Providence Bay, Siberia, where the "Bear" went annually to "blow" her boilers. On our return, too, we had helped Captain Amundsen's little ship "Maude" through Bering Strait, and now were back in Nome preparatory to our voyage through Bering Strait and east along the northern coast of Alaska to Point Barrow and Demarecation Point.

Nome is now a skeleton of the once flourishing city which stretched along the gold-bearing sands of Bering Sea. But in spite of its comparative smallness, it still remains the leading city of the north, and is the outfitting and starting place for the Arctic and the gold country north of the Yukon. In its well stocked stores are to be found an abundance of supplies needed in northern work, at prices little higher than "outside," and the accommodations



A KING ISLANDER'S HOME

Lacking level ground, the Eskimos build their houses upon poles, often lashing them to near-by rocks with lines of walrus hide

for travelers and outfitters are of the best. Mails are carried to Nome all winter by dog sled and airplane, so the winter isolation is little hardship, although the rigorous climate prohibits winter mining, as a rule.

We remained in Nome a few days, until the arrival of the S. S. "Victoria" from the south, and then the "Bear" sailed for St. Michaels, near the mouth of the Yukon, to take on coal for her northern cruise.

St. Michaels is built along the shores of a shallow bay. Numerous rocky islets and jutting peninsulas break up the monotony of the shore line, while small, cone-like mountains on the horizon—said to be old volcano craters—relieve the sameness of the rolling tundra. As with almost all northern cities, the glory of their past is greater than their present day importance, and the past of St. Michaels is portrayed by the steamship cemetery which lines the beach, a sad sight of many fine, old-time Yukon stern wheelers, pulled above high tide and



DRYING RACKS

The King Islanders have racks in front of their homes upon which they dry the skins of seals and walrus

slowly decaying. No longer do these boats ply up the great river, with their cargo of supplies for the interior, and



A SIBERIAN IGLOO

The homes of the natives of eastern Siberia are circular frameworks of poles, over which is stretched canvas or the skins of mammals. Heavy boulders aid the structures to withstand the terrific winds



Photograph by C. W. Scarborough

A KING ISLAND GIRL AND CHILD

A few months after making this beautiful photograph, Mr. Scarborough lost his life when his schooner was crushed in the ice to the eastward of Point Barrow

with miners, trappers, and pleasure seekers. A few boats handle all the traffic now,—the others are relegated to the junk heap.

A week was spent in this vicinity during which time coal was taken aboard and arrangements made for a few more passengers for the Arctic cruise, for to Captain Cochran was given the responsibility of carrying the teachers of the Bureau of Education to those little, isolated villages along the windswept arctic coast. We made Golovin Bay the morning of July 26, a beautiful sunny day. The precipitous cliffs which form

the harbor fairly gleamed; a cool breeze tugged at the flags and rippled the calm surface of the bay. A native came off with a load of salmon, a combination of modern and primitive man, sitting in the stern of his skin canoe—propelled by an out-board motor. Here the day was spent in taking on water, which was caught in a small, clear stream, and transferred to the "Bear" by the simple method of filling one boat and towing it with the launch. The Executive Officer, Mr. Parker, Hendee, and I experienced our first swim in Bering Sea, and for bathing in northern waters, it was very enjoyable. We hiked over the barren hills through alder patches and down steep slopes, now and then flushing a flock of ptarmigan from a thicket, or were anxiously watched by circling rough-legged hawks, a

pair of which we found nesting on an overhanging cliff.

We arrived at Nome early the next morning and set sail again in the evening for the Arctic cruise. The entrance to Port Clarence was reached by daybreak, but it was a foggy morning, so we worked our way slowly, finally dropping anchor off the reindeer camp; we rowed to Teller, which consists of a store, post office, and lighterage company. This is the finest harbor in northern Alaska; and should trade develop, is bound to become of importance as a shipping point. The "Lady Kindersley," the trading

boat of the Hudson Bay Company, had arrived ahead of us, and we found that one of their men was badly injured by being caught by a falling drum of oil, giving our doctor a busy forenoon. One cannot speak too highly of the "missionary work" of the "Bear" in caring for the sick of the settlements where medical attention is unavailable, furnishing transportation to remote places, and supplies to the needy.

Wales, the westernmost point of Alaska, is a little more than one hundred miles above Nome. We dropped anchor there one evening, after an interesting day's run along the rugged, mountainous coast. I landed some supplies at this village, as it was my intention to make the vicinity of Cape Prince of Wales the field of my spring work, traveling there from Barrow by dog sled, in March.



SIBERIAN ESKIMOS

The natives of Providence Bay, Siberia, dress in skins of reindeer even in July. The igloo is temporary structure for summer use



A SIBERIAN HUNTER

The natives use bird bolas—ivory balls on strings—to hurl into flocks of passing eiders. The strings wind around the flying ducks and bring them to earth

The natives of Wales are intelligent people, many of them speaking good English, and they are said to be the most thrifty of that part of the coast. They are of sturdy build, and appear capable of wresting their living from a frozen sea, but the population was small, as more than half the natives had died during the influenza epidemic of years ago.

The stop at Wales was a brief one, as only sufficient time was allowed to bring on the baggage of Doctor Greist and his family, who were going to Barrow to take charge of the mission and hospital of that most northern city.

Kotzebue lies on the right hand bank of Hotham Inlet, at the head of Kotzebue Sound, but the water of the sound is so shallow that we had to anchor about twelve miles from the village, on August first, after a pleasant trip across the open stretch of water. I was desirous



EMMA HARBOR, SIBERIA

Snow still covered the sterile hills when the "Bear" entered the ice-filled waters of Providence Bay, early in July

of collecting in the vicinity of Cape Blossom, so the Captain allowed Hendee and me a volunteer crew of five men and we landed at the cape, which is merely a high part of the tundra some thirty feet above the sea, with abrupt, mud-covered slopes. No rocks were visible, but solid ice extended to the surface where the banks were caved. The tundra was covered sparingly with dwarfed willows, and the white heads of "Alaskan cotton" nodding with every breeze, made the summer flats like a shimmering snow field. Placid lagoons dotted the broad expanse, mirroring the hurrying, fleecy clouds, while the resonant, echoing kok-ar-ow of the red-throated loon was a characteristic sound. Shore birds worked along the mud bars and a few arctic terns curved back and forth, now and then varying their flight with a headlong dive. We spent a busy afternoon collecting the wild life before us, and it was with regret that we noticed the hoisting of the pennant to recall us to the boat.

We were soon on our course toward

Point Hope, with a fair wind and a dirty sea, the waves rolling high with an occasional breaker washing the deck. Early in the morning the coastline was dimly visible through the curtain of mist and rain, a rugged, precipitous bank with foam-washed walls for the most part,—a gloomy and uninviting place. Cape Thompson, six or seven hundred feet high, with its overhanging crest crowned in a mantle of black clouds, loomed forbidding as we scudded past with all sails set; its steep cliffs dropped sheer into deep water, and its small crannies and gullies spouted little streams formed by the falling rain. About noon we reached Point Hope, a long sandspit extending into the Arctic, rounded it into the lee, and dropped anchor off the mission.

The native village of Tigara, with its sod igloos, is built upon the end of the sandspit,—a desolate setting, for there is no vegetation upon the point other than small grasses and a little moss; the winds sweep across with such violence that nothing can stand before it,—yet, the

site of this Eskimo village is one of the best in the whole country, for the ice shifts back and forth, allowing some open water for sealing throughout the year, and the long sandspit offers some shelter for boats no matter from where the wind blows.

This is evidently a very old village, dating far back beyond the memory of the oldest inhabitants; many a bleaching skull lies half buried in the sand, crumbling with time. A few years before our visit, it was decided to collect the scattered remains of the former inhabitants. A picturesque cemetery was made, enclosed with a fence of whale ribs, while the corners and gateposts were the enormous jaws of the bowhead. All the natives were enlisted in gathering the skeletons. A huge pit was dug and into this single grave were put five thousand skulls, and a large cross erected to mark the spot. Ancient implements of stone and ivory were found commonly in the old burial places, for the natives merely placed their dead upon racks, along with all the

possessions of the deceased; these were soon scattered across the drifts. The natives made a practice of gathering these curios for barter with the sailors, and so flourishing was the trade that several experts in the making of "ancient relics" developed among the natives, who deftly stained "old ivory" by boiling the new in coffee, and so whiled away tedious hours in the work of reproducing the weapons of primitive man. It was while a group of these natives were surrounded by the usual bunch of sailors that I heard an unique term applied to one of our domestic animals, a pig. The Captain had a couple of little porkers which were a great curiosity to the natives. Finally, an old woman, barely able to totter, looked at them searchingly and then grunted,—*"Huh, white man walrus."*

Point Hope was once a great whaling place, with a large number of whites who gambled at the exciting and profitable game. Now, however, with small demand for bone, few whaling ships come to the northern waters.



Photograph by Loman Bros.

WALRUS UPON AN ICE FLOE

Great herds of walrus migrate northward through Bering Strait into the Arctic Ocean each summer, returning into Bering Sea late in the fall



ROUGH-LEGGED HAWKS

These youngsters, found in a bulky nest, were placed on a rock to be photographed

continued; the next morning, August third, we made out the bold walls of Cape Lisbourne, famed to travelers of the coast as a dangerous place, both summer and winter, because of the severe winds coming from a clear sky with the suddenness which gives no warning. The stratification of the rocks with the bell-shaped

Bird life was abundant in individuals that stormy afternoon, especially sandpipers which fed along the little lagoons and pools that covered the rain-soaked spit. Red-backed, pectoral, and Baird's sandpipers, red phalarope, black-bellied and golden plovers swirled around in flocks, while several bands of pintail, the kug-a-ruk of the Eskimo, rose from the grass-bordered edges of the ponds. Murres passed at sea by the thousands, en route to and from their breeding grounds on the sheer cliffs of Cape Lisbourne, while snowflakes and longspurs hopped about almost underfoot. Little time was spent at the point, just long enough for an officer to serve sub-pœnas to the natives,—for it was there that a white man killed the missionary the year before, and the trial was to be held at Nome the next month.

Anchor was raised and our way up the coast was

WILLOW PTARMIGAN

These protectively colored grouse were found nesting among the willows. They have white feathers in winter

antielines, was plainly visible, while dense growths, evidently of alder or willow were seen in some of the valleys. Sea birds, horned and tufted puffins, and murres skittered over the surface of the water, while a few kittiwakes hovered alongside.

There was little ice in the Arctic, along the northwest coast, but we plowed through occasional fields. Seals and herds of walrus were congregating upon many of the pans, and they were not interested enough to raise their heads when we passed. The little village of Elronik—Wainwright on the map—was reached the



SNOWY OWLS

A nest containing young snowy owls was found upon the tundra near Nome

evening of August fifth, and it was there that Hendee and I were to spend the winter, so, naturally we were eager to see our new home. As we landed, we found the whole village congregated below the low bank facing the ocean, to bid us welcome, a quaint group of Eskimos in their skin parkas and boots.

There was a cluster of thirty odd igloos, inconspicuous against the drab tundra, but the school house and the trading station of Jim Allen seemed to tower in the sky. The tundra is slightly rolling, typical northern prairie dotted with lakes, solid ice prevailing a few inches underground, the worn surface of which glistens along the cut banks facing the beach.

Hendee remained at Wainwright while I went on with the "Bear" when she left early the next morning. We had a cool delightful day on our run to Barrow, with a fair wind and a choppy sea. Several herds of walrus were seen, a mother and



her calf coming up alongside, the old one rising out of the water to glare at us as we passed. Not a speck of ice was to be seen on the distant horizon,—unusual conditions for that latitude,—so rapid time was made to the most northern of our American cities, Barrow, the home of a dozen white people and about four hundred Eskimos.

For "southern hospitality," one has to go to the Arctic, and the two days spent at Barrow were pleasant ones. The supplies for the school were unloaded during the night, in spite of a rather disagreeable swell, as the Captain was anxious to get started for Demarcation Point, far to the eastward. Barrow is situated within nine miles of the northernmost point of Alaska and is a bleak and lonesome looking place, being just a few feet above the sea, with nothing but a broad expanse of level tundra in the back-



SANDPIPER CHICKS

The nests of these Aleutian sandpipers have been found and photographed by few naturalists



AN IGLOO AT CAPE PRINCE OF WALES

The Alaskan Eskimos build huts of drift wood and sod, which are entirely different from the circular dwelling places of skin made by Siberian chuckchees. The Alaskan huts are usually buried under snow in winter, with access through a doorway at the top. Note the cache with walrus hides drying



RUSSIAN FORT

This little stockade at St. Michael is a reminder of the days when Alaska was ruled by the czars

ground, but it is one of the most desirable stations of the whole coast because of the fur taken there each year from polar bear and arctic foxes. In other times this was the site of the most famous of whaling stations, and a history of Arctic Alaska would contain much of interest dealing with this remote village. Here it was that most of the whalers were ice bound in 1897, when the "Bear" went to their rescue. Arctic explorers have visited Barrow during their travels, but its fame as a whaling station alone is sufficient to give it renown.

Probably the most interesting person one could meet in the whole north country is Charles Brower, who is in charge of the trading station at that point, a man of fifty years' experience in Alaska, coming as he did when the natives were still in the "stone age" and used primitive weapons of stone, bone, and ivory. Mr. Brower speaks the language of the Eskimos and is probably more acquainted with their traditions and understands them better than any other man.

The trading post is built upon a little knoll, while half a mile to the south, separated by a salt lagoon, is the school building, the church and manse,—and a modern hospital. The Mission at Barrow is in a position to do practical missionary work, for the Presbyterian Church has built this fine hospital and has sent a competent physician and a nurse to conduct it. There is no other doctor within eight hundred miles.

Barrow is considered one of the dangerous places of the arctic coast, for the ice generally crunches in by the middle of September; many an ice captain has found to his sorrow that he delayed his departure a few days too long. This season was a remarkable one, however, for little ice could be seen upon the horizon, although large floes had been visible a few days before, the natives killing a good many walrus and seals among the bergs.

The evening of August eight, with Mr. Watkins of the Geodetic Survey, who had come on the "Herman" from Nome to



A NATIVE OF WAINRIGHT

The Eskimos are not picturesque figures during the summer, when they are dressed in worn skins



LANDING NEAR DEMARCATION POINT

Lieutenant Todd is guiding the cutter through a passageway in the grounded shore ice off the international boundary line

Barrow, we set sail to the eastward, going through considerable ice after we rounded Point Barrow. The next day was a fine one, cool and bright except for a little fog in the morning; we wormed our way through the pack ice, turning here to escape a cake, or there to follow an open lead. Occasionally we scraped one floe, only to strike another head on, the "Bear" quivering as her bow rose high in the air, with engines reversed. About 3:00 P.M. the ice grew too thick for us, with no apparent lead, so we were forced to turn and work our way back, anchoring for the night off Point Halkett. Life was scarce, only a few gulls, a jaeger, and some seals being about, with the exception of two polar bears being seen in the morning. August tenth was spent trying to make a landing at the Cape, as Captain Cochran desired some data on the coast line. Lieutenants Parker and Todd and myself, with a crew of five men, started early; it was a rather blustery day with a fair wind ashore, so we made

good time, but owing to the shoal water and the strong surf, we were unable to land. We tacked back and forth several hours, taking aboard wave after wave, until we were drenched to the skin and utterly miserable before we were finally back on the ship and once more en route for Demarcation Point.

We traveled all the next day through the Arctic pack, occasionally finding open stretches where we could go at full speed ahead, again having to wind our way along tortuous leads, now bucking our way across a narrow bridge of ice, again being inside of the main pack; so close inshore had the ice been held by the unfavorable northeast wind that we were forced into three fathoms of water off Cross Island. There is a chain of small islands extending along the coast, low, sandy spits with scant vegetation. Challenge Island was passed about sundown, where we saw the schooner "Teddy Bear" which had spent four years frozen in, in Banks Land, and continued on our way all night, although ice conditions were such that scarcely twenty miles were made. When the fog cleared off the morning of the twelfth, we were off Flaxman Island, which is higher than Cross Island, but scarcely more inviting. Our day was a repetition of the preceding one, although better going as a whole; however, a heavy fog about four o'clock, and a head on collision with a berg, stopped progress for the night. We pulled anchor at 4:00 A.M. and had good traveling at half speed all morning. While writing in the cabin, I was attracted by the calling of an arctic tern, and going on deck, I found it darting at a gyrfalcon, which seemed to desire to alight on the ship. A little later we saw two old squaw ducks with a brood of half-grown young, the old birds taking to wing while the youngsters dived, finally coming up at a distance, each apparently having chosen a different direction.

In the afternoon we heard a shot, and



RUSSELL W. HENDEE AND JERRY

Mr. Hendee was a member of the Colorado Museum expedition. It was a great loss to science when this experienced young field naturalist lost his life on a recent field trip to Indo-China.

on stopping, made out a whale boat sailing in the fog. It proved to be a bunch of natives and a chap named Lowen, who was dressed in skins of the mountain sheep. Lowen had been living along that part of the coast for seven years and was now desirous of a little "white man's grub," in exchange for skins of the arctic fox. He was a rather unique character who whiled away the monotonous hours by building igloos along the coast, a practice which the natives soon learned to take advantage of, by following him and taking possession as soon as he abandoned them.

The fog settled early, so we anchored off the trading post of Tom Gordon's, which is situated four miles to the westward of Demarcation Point; a more uninviting place for a white man to spend his life could not be found. But it is in a rich fur country, and where foxes are, the white traders will go. Gordon came aboard in an ugruk skin canoe with the usual band of native followers. The wind, which had been blowing hard, increased to a gale and kicked up such a sea that he could not go ashore again. Gordon reported mountain sheep and caribou plentiful in the mountains, which rise up fifteen miles back from the beach,—the Romanzof and British mountains. His post took in one thousand foxes the year before but very few polar bear. Walrus rarely go that far to the eastward, the natives having to depend upon the skins of ugruk (bearded seal) for their oomiaks.

It blew all the next day, and as the sea was clear of ice, quite a swell was thrown up and Gordon was not able to land until evening. We then ran down to the boundary line and anchored among the loose ice, where the waves were broken. Captain Watkins went ashore early in the morning to attend to his geodetic work, an officer signaling from the crow's-nest the direction for the boat to take through the narrow ice leads. Inshore



AT THE INTERNATIONAL BOUNDARY LINE
Mr. Bailey standing beside the northernmost boundary monument in the United States. The metal post is marked "Canada" and "United States," on their respective sides

were great bergs of old ice, so it was with difficulty an open channel was found. In the afternoon I went collecting on the tundra, finding many shore birds, especially Baird's and pectoral sandpipers, as well as rock ptarmigans, gulls, and a few terns.

Our northernmost boundary point is a metal post about five feet high, marked "Canada" and "United States" on their respective sides, and is within one hundred yards of the Arctic Ocean. Inland the monotonous, flat, lagoon-studded tundra stretched to the distant mountain ranges, while at sea was the Arctic pack, with the trim little "Bear" almost "hull-down" among the bergs of old ice. It was the farthest east in the Arctic that the coast guard boats had ever worked.

Our task accomplished at Demarcation Point, we started on our return. We cut through the pack near Griffin Point where we made a trip ashore, to investigate the condition of the natives at that place, and then ran down to a

native village at Humphrey Point. Only old women were at home in this primitive little settlement; all the other natives were busy catching white fish in their crude gill nets. There had been an asphalt lake reported from that vicinity, and by way of obtaining information on its location, we approached a wrinkled, bowed old woman, who had a ready laugh and an appetite for cigarettes, and showed her a piece of tar. She pointed across a lagoon and said, "*mani*," but our time being too limited, we could not locate it.

The next two days we worked through the ice and anchored off Cape Simpson the night of August nineteenth and made a landing the next morning, in order to investigate an oil seepage there. This proved to be on a knoll, a broad river of oil running to a large lagoon whose shores were coated with the thick residue. Several parties had been staking oil claims in this vicinity the past few weeks, and this particular seepage was claimed by at least three parties. That evening we were en route for Barrow, arriving early in the morning. The mail and a few passengers for the outside were taken aboard and we were

under way immediately, as the season was growing late and all the work had been accomplished.

My last day on the "Bear" was one to be remembered, for we skirted along the incoming pack, the great columns being miraged above the horizon, some shimmering peaks as though suspended in the air, others as broad masses balanced on needles of ice. A herd of walrus sported off our bow, and another small band was seen upon the pan ice,—huge, clumsy beasts, their white tusks gleaming against the blue of open water. Glaucous gulls followed the ship and occasional bands of black brant hurried southward, flying close to the water and making all haste, even as was the "Bear."

The next morning we arrived at Wainwright with a rolling sea, but the natives managed to get their skin boats through the surf, and I was landed, to carry on my winter work at that little Eskimo settlement. Soon the "Bear" was only a speck on the distant horizon, and one more year was to elapse before a breathless Eskimo would come bursting into the house, exclaiming,

"Oomiak puk—the "Bear"—it come!"



BERING SEA IN A PLACID MOOD, FROM THE DECK OF THE "BEAR"





Photograph from Ewing Galloway

A Korean Village

DIAMOND MOUNTAIN TRAILS

Two American Women Take a Walking Trip in Korea During the Rainy Season

By ETHELYN G. NELSON

PHOTOGRAPHS BY MARY SMITH EXCEPT WHERE OTHERWISE NOTED

SCARCELY a glance did my traveling companion and I bestow upon the natural wonders we had come all the way from Peking to see when we finally alighted from the rickety Ford that had jolted us with disconcerting speed from our boat at Chanzen, five miles away, to the village of Onseiri in the Outer Kongo. Why? Well we were just plain famished, having endured an almost complete fast, not to mention loss of sleep, since leaving Seoul some twenty-four hours previously.

Pastor Yun, native missionary and proprietor of the attractive little inn, must have been impressed by our lean and hungry look, for he lost no time in giving us the cheering news that he had recently acquired a cook with experience of the peculiar tastes of foreigners and would be glad to provide meals for us. This came as an agreeable surprise, since missionaries familiar with these parts had

told us that inasmuch as Korean food is usually not acceptable to the western palate, it was customary for foreigners to bring supplies with them and prepare their own meals, a brazier being provided by the inn for cooking purposes. We had brought nothing of the sort, taking a rather long chance that there would be a village store where we might forage.

It appeared that my companion, Mary Smith, of Andover, Massachusetts, and I were the first guests of the season and, being given a choice of rooms, we selected two overlooking the river, which flowed just outside the narrow limits of the inn grounds. Naked army cots comprised the entire furnishings of the rooms, except for muslin curtains at the windows, which afforded a slight degree of privacy. Anticipating this, we each had in our duffle bags a blanket. To remove the dust of travel, a small basin of water was brought



A WAYSIDE TEMPLE

To be fully appreciated, this quaint little building should be seen in its picturesque setting of wooded hills, where its bright coloring is enhanced by the surrounding verdure

to us and placed upon the floor. Later we learned to follow the practice of the natives—took our towel and soap to the stream where running water was freely supplied.

After a meal which proved the cook's claims to be not unfounded, we strolled forth to judge for ourselves just how exaggerated were the glowing descriptions furnished by the Japanese Tourist Bureau of this region of Kongo-san. Immediately we were abashed that we had permitted mere material needs to distract attention even temporarily from such surroundings. The Diamond Mountain, with its forests, its streams, its towering peaks, laid its spell upon us at once and for all time.

Actually Kongo-san, called by foreigners the Diamond Mountain, is not a single mountain but a great cluster of some twelve thousand lofty peaks. Even in the days of Buddha, more than two thousand years ago, the region was famed for its beauty, and it has been the Mecca of Buddhist pilgrims ever since. Legend has it that about the beginning of the

Christian era there came to Korea out of India, the land of Buddha's birth, fifty-three of his disciples who, miraculously led by a deer, a crow, and a dog, found their way to the mountain and erected upon its steep sides many monasteries. Two centuries later, more than a hundred such temples were in existence. Today only thirty-two may be numbered, many of them in situations so difficult of access that they are seen by few except monks and pilgrims. We classed ourselves with the latter and dreamed of seeking out many a hidden shrine during our pilgrimage.

It may have seemed a hazardous and foolish undertaking for two women to go rambling around through a wild and sparsely settled region with no knowledge of the language spoken, and in former days this would certainly have been true. Then Korea was the resort of the big game hunter, whose great ambition was to adorn his study floor with pelts of the fierce tigers and leopards which were the terror of the natives. Koreans adopted the custom of removing from the vicinity

of their roads and houses everything in the way of growth that might shelter these beasts, and to such an extreme was this carried that Korea has been called "the treeless land," it even being considered disgraceful at one time to permit a tree to grow in the dooryard. I am not informed as to how many of the numerous other wild animals having their habitat in Korea are yet to be found there, but of this my friend and I were assured—the last tiger in the Diamond Mountain met his doom in 1911.

As to the natives themselves, Pastor Yun gave us his word that they are positively the most honest of all people. He maintained that if a traveler should carelessly leave his purse by the roadside and come back for it a week later, he would find it exactly where he left it with contents intact; and that a woman might travel alone over the entire country without possibility of harm to her person, unless from falling over a precipice or into one of the many streams.

Dwarfed by the magnificence of nature,

the tiny village of Onseiri, with its low, thatched houses, was hardly noticeable. Few people were about, and these mostly women and children. An occasional Korean male might be seen lounging on his veranda, clad in flowing white garments, hair knotted on top of his head and surmounted by a miniature hat of horsehair resembling nothing so much as a flytrap; or a lordly Japanese stalked along, kimono draped majestically around him. Koreans apparently have no liking for the existing political regime, notwithstanding the fact that the Japanese have introduced many improvements as regards methods of agriculture, increase of fisheries, care of the public health, suppression of disease, and so on. An indescribable look would appear on the face of Pastor Yun when the present rulers were mentioned, and when we asked him if his children were attending the school just across the stream from the inn, he responded scornfully that no Korean child got a chance to go to school until all the Japanese children were accommodated.



WHERE BEAUTY DWELLS

The pleasure of looking upon this gem of temple buildings at U-jam-sa was compensation to Mrs. Nelson and her companion even for a night in the rain and a week of dieting

The chief occupation of the village women seemed to be washing clothes. In view of the fact that both men and women dress in white all the time this was undoubtedly necessary. The washing club met daily in the middle of the river and exchanged the latest gossip while vigorously hammering away at garments spread out upon the rocks. Later on, from the houses issued the continual rat-at-tat-tat of paddles, indicating that these same garments, wrapped around a wooden cylinder, were having the wrinkles removed by a similar beating. Someone has given in explanation of the custom of wearing white, the badge of mourning, that at one time the people were so constantly in mourning for an emperor or some member of his family it was decided to save trouble by wearing it always. The dress of the women consists of a very full skirt and short jacket, with usually three or four inches of bare skin showing

between the two; while the children look like miniature old people, except for the smallest ones, who are clad merely in a short upper garment barely covering the shoulders.

The almost entire absence of men in the village was due to the fact that their principal occupation is the carrying trade; in other words, they are "jiggy men," the load, which is piled high on a wooden frame borne on the shoulders, being called a "jiggy." They also serve as guides to tourists who wish to explore the mountain paths, and Pastor Yun was only acting in the interests of home industry when he insisted that we should employ a guide whether we wanted one or not.

Our host was a man in his middle thirties who had been trained in a foreign mission school—hence his knowledge of English. His inn was the vacation resort of those missionaries whose field of work lay in Korea and it was through some of



Photograph from Ewing Galloway

RICE PADDIES

Rice is the main crop of the Korean farmers, and, together with fish and greens, forms the principal food of the natives



Photograph from Ewing Galloway

WATER WHEEL

Rain is usually not lacking in the Diamond Mountain region, but water from the shallow streams is sometimes raised to the rice terraces by the above means

these that we were directed to it rather than to the Onseiri Hotel, which was run by Japanese. Sitting beside us on a bench at the back of the inn that first evening, while we watched the wide, shallow river foaming and tumbling about the huge boulders which impeded its course, he dramatized for our benefit an exciting experience of the previous fall, when his place caught fire in some mysterious fashion and burned to the ground so speedily that he barely had time to rescue his family, their entire possessions going up in flames. After all his efforts to live a Christian life and lead others to do likewise, this was his reward! "I was ready," he exclaimed, "to curse God and die!" Fortunately his faith was soon restored by the sympathy of his fellow workers, who collected and sent to him sufficient funds to enable him to build and furnish his present inn and carry on as before.

By way of inuring ourselves to hard-

ships before attempting anything very strenuous, we inquired as to the least difficult climb in the neighborhood. A peak called the Punch Bowl on account of its domelike bald crown was pointed out. We found this indeed easy, or would have done so if we had not mistaken the directions given and gone somewhat off the beaten path into a jungle from which we had considerable difficulty in extricating ourselves. How Pastor Yun would have laughed had he known this, after our refusal to take a guide!

While resting on the summit, eating our lunch and enjoying the fine view, we were so fascinated by the white, sandy beach far below us that we instantly resolved to make that the scene of our next trek. Accordingly, the following morning we made an early start, climbed over the ridge which lay between Onseiri and the sea, and ran down, down on the other side to the water's edge. The odor of drying fish announced the presence of a



U-JAM-SA INN AND A JIGGY MAN

After a week's enforced idleness in the mountains due to rain and floods, Mrs. Nelson and Miss Smith were brought through safely to Choan-ji by this jiggy man

fishing village even before we caught sight of the small cluster of houses. The men were probably out with their boats, the women engaged somewhere in the rice paddies, and we had the beach to ourselves. When finally we tore ourselves away from this refreshing dip we took the longer way around the base of the hill instead of over the top, passing paddy fields where women were standing in water to the knees, transplanting rice, in many cases with a husky child astride their backs.

The inn, which by now we had come to consider our private habitation, was that evening invaded by a missionary and his children, a boy of ten and a girl somewhat younger, come for a few days' vacation. This proved a piece of luck for us, as they were planning to make on the morrow the very trip which Pastor Yun had warned us we positively must not make without the assistance of a guide, being entirely too dangerous for women to undertake alone. Consequently, while secretly somewhat disappointed that this so-called "dangerous trail" was apparently simple enough

to be negotiated by two children, we jumped at the newcomer's suggestion that since he was well acquainted with the route we had better accompany him and the children.

The morning was glorious and the whole party set out in high spirits on the eight- or nine-mile tramp to Nine Dragon Pool. After a fortifying draught of ice cold water from the spring just outside the village we immediately began the upward climb and kept steadily at it until the summit of a hill with a commanding view was reached. Here we paused to rest and enjoy the scene before entering the thick woods which lay beyond. To our left the fantastic granite crags of Bambutsuso formed an unforgettable skyline, while below a dense mass of waving verdure stretched away to lose itself in the azure sea, sparkling in the early morning sun.

Turning again to resume our walk, in a short time we came in sight of a little monastery, its tiptilted roof and bright coloring making a delightful picture

against the green hillside. We ventured to look in at the open door, where a priest was kneeling before a gilded Buddha. Too absorbed in his devotions to notice us, he kept on with his chanting, accompanied by the regular tapping of a bell.

From here the trail mounts continuously, crossing and recrossing a swift and turbulent stream of water. There are no bridges, only an occasional log. One must step, or jump, from boulder to boulder, with imminent danger of slipping off the rounded surface and getting a ducking. At a few of the more ticklish places wires have been stretched to assist the traveler in maintaining his balance. The surroundings are wild and beautiful. At one place a series of jewel-like pools connected by cascades has been poetically named the Jade Necklace.

Somewhere around the noon hour a loud roaring came to our ears. Could that be the dragons, warning us not to approach? No, since these were driven out or exorcised long ago by the party of priests whose abandoned stone boat was pointed

out to us along the trail. We turned a sharp bend and the mystery was solved. The picture revealed brought us to a rapturous pause. On the opposite side of a *rincon*, floored with solid rock and hemmed in by steep cliffs of three or four hundred feet height, a mighty fall of water dropped with thundering sound. The dark and shining pool which receives it is said to be bottomless and it is here that in former days the dragons disported themselves.

Before leaving the Outer Kongo there was one more height to be attempted—a peak of the Bambutsuso. This was really mountain climbing. The trail in the end became so nearly perpendicular that progress was attained chiefly on hands and knees. We met in one place a party of returning Japanese tourists, who sadly shook their heads at us as they passed—a gesture which might be variously interpreted. When finally a point was reached where it became necessary to hoist oneself by means of a wire, with scarcely anything in the way of a foot-



KOREAN CHILDREN

They are demure little tots, and seldom is the seven- or eight-year-old lad seen without his baby brother strapped to his back, sleeping profoundly



ALONG THE TRAIL TO CHOAN-JI

Granite peaks rise, one behind another, to sublime heights, rivaling in grandeur and beauty those of the Alps and the Rockies

hold, I sat down and firmly refused to take another step. If anyone wanted to climb the old mountain they had my permission, but as for me I was through. My companion would not be vanquished without a struggle, however, and after pulling herself up to the next ledge by means of the wire, disappeared from view—for a very short time. Then she, too, returned, and—being presumably right under the peak, surrounded by shrubbery obstructing the view—to this day we do not know how near the goal we were.

Our host of the inn would fain have detained us longer, but the only added attraction he had to offer was the Sea Kongo and that could be taken in on the next stage of our itinerary. The same old Ford with which we were familiar conveyed us to this place—a beautiful seascape formed by grotesque rock pillars rising from the water—and after allowing us half an hour's stroll on the beach in which to admire, continued the drive to the foot of the mountain over which we proposed to take our way to U-jam-sa village.

Eager now for new worlds to conquer, we crossed the inevitable stream of water on slippery stepping stones and started up a steep but excellent trail. For the most part we traversed thick woods, only at rare intervals coming to a point where there was any outlook. At such places we rested, eased the increasingly heavy pack from our shoulders, and enjoyed for a time the scene of romantic wildness which expanded in every direction. Although, as has been said, Korea in general is more or less barren, the mountain regions are heavily wooded and the Diamond Mountain is no exception. Pines, maples, junipers, mountain ash, and numerous other trees and shrubs clothe the rugged slopes with their varied shades of foliage, while azalias, rhododendrons, iris, and a profusion of smaller flowers add their charms. And water, water everywhere, clear, cold, delicious—water to drink without boiling! Coming as we did from dry Peking, we fairly revelled in it. In the end, it will be seen, we had almost enough to satisfy us.

But few people were encountered during the day--one jiggy man, some lumbermen sliding timbers into the cañon on wire cables, a woman beside a wretched hut. About five o'clock we approached a couple of buildings which we surmised might be our destination. One was apparently an inn, the other a small stand where lukewarm ginger ale was dispensed to the thirsty traveler.

It was not our intention to patronize the inn here, most Korean inns bearing an unenviable reputation as regards vermin, so while the natives eyed us with obvious amusement, we marched by, looking for a suitable place to pitch camp. Only then was it borne in upon us that these mountains were very ill adapted for such a purpose. With the exception of the creek bed most level spots had already been preempted. However, after scouting about a bit, we discovered a path leading to the top of a slight eminence that seemed promising, and on investigation this seemed a secluded and ideal situation. Hastily dumping our packs we ran down the hill again to take a look at the monastery which had been glimpsed just around the bend.

Spanning the creek was a covered wooden bridge, the walls and ceiling of which were completely lined with inscribed tablets, whether placed by pilgrims to the shrine or for what purpose we could of course not make out. Flourishing vegetable gardens bordered the path leading from the bridge to the monastery buildings, which were constructed in the usual fashion, with quaintly curving roofs of reddish tiles sup-

ported by curiously carved rafters painted in bright reds and blues. Gongs and bells were sounding, and priests could be seen at their prayers. A fat cook was peeling vegetables at the door of the kitchen. Following a path that led upward, we found another group of temple buildings farther up the hillside, where we were greeted and shown around by a fine looking young priest.

Daylight began to fade and, hastening to our camp, we arranged our beds and settled ourselves for a night under the stars. Almost immediately thereafter to our dismay a few raindrops began to fall, which rapidly increased in number to a steady downpour. This was a situation for which we were poorly equipped. Soon we were soaked to the skin. For-



NINE DRAGON POOL

A nine-mile climb over a rough trail brought the travelers to this charming cascade tumbling from a great height into its dark-green basin

tunately the night was mild and we suffered only discomfort, but sleep of course was impossible.

Not the slightest expression of surprise was evidenced by the innkeeper next morning at the early appearance before his door of two bedraggled individuals seeking admittance. Bringing wooden bowls of warm water he indicated that we should cleanse our feet before stepping upon the immaculate white matting of the room assigned to us. In addition to the matting the room contained two wooden headrests. The walls were of thin sliding panels, the doors and windows of rice paper.

As we stepped into the room we exclaimed at the lovely feeling of warmth in the floor. Korean houses have central heating, as it were. That is, a furnace is built at one end of the long one-story building, from which a flue runs under all the rooms to convey the heat. Our room being at the furnace end, if a guest at the other extremity clamored for more heat, we came near being broiled, since the

floor was both seat and couch. But this morning, somewhat chilled by the night's experience, we had no quarrel with the temperature.

And now, the rains came and the winds blew and the floods descended for six consecutive days, while we sat and slept and—I was about to say ate, but they did bring us a table about eight inches high—on that matting-covered floor. Our small store of canned goods gave out in a couple of days and thereafter our diet consisted almost solely of boiled rice seasoned with black sea-water salt. Growing desperate, we implored our landlord in the best sign language we could command to get us a guide and let us go forth rain or shine. By the same method he managed to convey to us that if we did so we should have to wade in water to our necks and no jiggy man would undertake to get us through to Choan-ji under such conditions.

Eventually there came a lull in the storm, and after allowing a day for the angry waters to calm themselves a trifle,



THE COVERED BRIDGE AT U-JAM-SA

Many inscribed tablets cover all the available ceiling and wall space under this roof



AFTER THE FLOOD

This bridge hung by a mere thread the morning Mrs. Nelson and Miss Smith departed from Choan-ji, and it was with considerable trepidation that they walked gingerly across it

we were permitted to resume our journey. The freshly bathed earth sparkled and shone, smiling secretly no doubt at the joke played upon these travelers. We ourselves would have joined the birds in a pæan of thanksgiving, except for the necessity of conserving our breath in order to keep up with the long strides of our guide. He was a personable young man with a professorial brown beard and an excess of dignity which caused us to stand somewhat in awe of him.

When after about three hours we found ourselves standing upon the summit of a ridge and looking over into a narrow valley almost entirely occupied by a wide, shallow river, "There," we thought, "must be the water the landlord was warning us about." Sure enough, when we reached the brink of this stream the jiggy man walked calmly into it as a matter of course and we followed suit. It was by no means easy to keep one's footing on its rock-strewn bed with water swirling about, but we reached the other side without accident and sighed with

relief—prematurely we soon learned, for this was but a beginning. For hours we traveled back and forth across that river, wondering all the time why it wouldn't have been simpler to go straight down the middle of it. Sometimes the water was only knee-deep, at others to our waists, with a current so strong that we could with difficulty keep our feet even with the guide's assistance. But at last, late in the afternoon, we emerged upon a hillside overlooking Choan-ji and saw below us a paved road, a picturesque hotel, and folks in white attire having tea on the lawn!

In the midst of pine-clad hills, at the junction of two mountain torrents, we found Choan-ji, in the Inner Kongo, even more charming than Onseiri. The half-dozen guests at the hotel had also been awaiting weather favorable for sight-seeing. Taking advantage of the first clear day, they were starting next morning on a trip to a certain famous monastery in the neighborhood. We might have joined them, but thought it wiser to rest

for a day. Here is where we lost out. Before the return of the expedition that same evening the skies opened again for another week of continuous rain.

It is only fair to say that we had been warned of this before ever we left Peking. We knew that July was rated as the beginning of the rainy season in Korea, but as my fellow traveler, Miss Smith, at that time connected with the Peking American School, had only a certain time free, we offered up a prayer to the weather gods and went anyway.

The close of that week brought the end of the world—at least so far as the Inner Kongo was concerned. Bridges were washed away, telephone lines put out of commission, even jiggy men could not reach us, and supplies at the hotel ran so low that the proprietor showed unmistakable signs of being anxious to get rid of his guests. We ourselves were quite ready to move on, but it was now impossible to go by auto-stage to Seoul as planned—there was no road! Nothing was left but to leave the mountains by the way we had entered.

Some adopted the luxurious method of being carried to Onseiri by a somewhat roundabout way in sedan chairs, but Miss Smith and I had been deprived of too much of our month's walking tour to

make such a compromise, and being advised of a trail which left U-jam-sa on one side and obviated the necessity of again contending with that ubiquitous stream, we quickly made up our minds to walk. Furthermore, we determined to do the whole twenty-five miles in a day, having no faith this time that the rain would hold off for more than twenty-four hours. So we got up bright and early, engaged two jiggy men to convey our luggage, disregarded the fine drizzle that was still falling, and set our faces toward the coast.

It was a hard day's tramp, and the so-called trail was hardly more than a rocky gully most of the way, but for no easier mode of travel would we have foregone the privilege of once more viewing those magnificent peaks on all sides as they expanded before us in our ascent of the mountain. And when in the evening, weary and footsore, we dropped on a bench before the inn at Onseiri, we were well satisfied.

Morning found us once more on the little steamer, bearing out on the Japan Sea, and as Bambutsuso's crags faded gradually from sight we agreed that given the opportunity, under the same conditions, and with our present experience behind us, we would gladly pack our duffle bags and do it all over again.





A Wind-blown Mountain Hemlock near Timberline

THE FORESTS OF MT. RAINIER

The Impressive Forest Growth That Surrounds the Great Extinct Volcano of the Puget Sound Region

By C. FRANK BROCKMAN

MT. RAINIER, a great volcanic pile with many glistening glaciers, is effectively set in a sea of forest green which clothes the lesser ranges at its base. Like a brilliant diamond, whose sparkling beauty is enriched by contrast with surrounding emeralds, so the majesty of "the" mountain is enhanced by the verdure of the forests that encircle it. I say "the" mountain, for Rainier, 14,408 feet high, looms so huge upon the skyline from Puget Sound that it dwarfs other geographical landmarks by comparison. It rises, not from a high plateau, but from a comparatively low base—a scant 4000 feet above the sea, and from Puget Sound, hardly fifty miles distant in an air line, it seems to rise directly from the water's edge. Tier upon tier of green-clad hills build to a crescendo of sparkling white of perpetual ice. Truly, Rainier is "the" mountain!

Today much of the timberlands that once stretched away from Rainier's upper slopes to the placid waters of the Sound have succumbed to the woodsman's axe, and the great mountain has been made easy of access by broad highways. But at one time these woods served as a barrier to man's attempt at intimate acquaintanceship with this extinct volcano. For years after Vancouver first saw and named it, these forests effectively guarded from the eyes of man the rich beauty and lavish display of nature characteristic of the region about Mt. Rainier. Tolmie, who in 1833 first set foot on land now within the boundaries of Mt. Rainier National Park, wrote of the impressive solemnity of these forests and the difficulties of penetrating the near-jungle of underbrush that grows in the dense shade of these woods.

Later, in 1857, an American army



Courtesy of the National Park Service

AMID THE PARK-LANDS OF HUDSONIAN ZONE

Ranger-naturalists daily conduct parties on short hikes to points of interest

lieutenant, A. V. Kautz, struggled for days through this forest labyrinth in an effort to reach a point from which an actual attempt to scale Rainier's lofty summit could be made. He dwelt at length in his account of this journey on the hardships which he and his small party endured.

"There was nothing definite," he wrote, "except forest, of which there was a great excess . . . our progress was exceedingly slow on account of the undergrowth . . . there seemed nothing but forest before us; dark, gloomy forest

remarkable for large trees and its terrible solitude."

Such a timberland is now preserved within the boundaries of Mt. Rainier National Park. Visitors today—as was Kautz in 1857—are impressed with the large trees and the woodland's "terrible solitude." One finds here almost wholly a coniferous forest. But a half dozen trees other than conifers are included and these are scanty in their distribution. Great Douglas firs, hemlocks, and western red cedars rear their huge trunks six, eight, even ten feet, in diameter, sometimes from two hundred to three hundred feet above the ground. Far overhead their branches interlace to form an evergreen canopy that is almost impregnable to the sun's brightest rays.

And so we find here a condition of near twilight; of moist, cool, humid quietude that is re-

reshing and conducive to uninterrupted interest in the great variety of growing things about our feet.

So shaded is the forest floor that only plants tolerant of such shade can exist. Off the trails one is forced to push his way through a mass of devil's-club whose spiny leaves and stems pluck at one's clothing and scratch, sometimes painfully, exposed parts of the anatomy. One must scramble over numerous logs in all stages of decomposition which themselves support the life of new seedlings. The forest floor is soft, spongy, and yielding—the result of

years of accumulation of humus and forest litter. And from this decadent evidence of a past forest, numerous mushrooms take their life. Russulas, Clavaria, the exquisite hydnum, the brilliant orange of the sulphur polypore and many other types of fungus growth vie for one's interest. In fact here one can readily "climb the family tree of the flowers" within a few feet of where one is standing. Algæ may be seen in quiet, stagnant pools; the slimy consistency of the myxomycetes or slime molds can be readily seen; liverworts and mosses of many species abound—growing over "down" logs and obscuring rocks from view with their soft, green, compact vegetative tapestry. Ferns of many kinds, from the well known bracken to the delicate maiden-hair, are everywhere. Lichens have at-

tached themselves to the tree trunks, thus adding to the complexity of this botanist's paradise, and the flowering plants, too, bid for one's interest. It is, however, not a gaudy display. The color scheme is green in its many tones and variations. Only rarely does some individual appear striking by contrast to the subdued tones of its background.

Throughout this labyrinth of plant life, almost tropical in appearance and diversity of plant forms, one marvels at the great amount of "clear length"—as the lumberman would say—of the various trees. Their trunks are often free of branches for nearly a hundred feet or more. But we need not seek far for the answer to this. Sunlight is decidedly lacking in these woods and sunlight is necessary for the growth and develop-



A VISTA OF MT. RAINIER

Emmons Glacier, the largest glacier in continental United States, may be seen in the central background



THE SILVER FOREST

Alaska cedar, fire killed for more than fifty years, largely composes the "silver forest" in Mt. Rainier National Park. During the passage of the years, the trunks have weathered to a beautiful silver-gray

ment of foliage. On account of this the foliage of the lower branches dies, then the branches die also, and finally, as the tree slowly increases in diameter, they slough off and drop to the forest floor.

We see many evidences of this "self-pruning" process going on everywhere. Groups of young trees of little more than pole stage are engaging in an epic contest that will be decided years hence, by the law of the "survival of the fittest." In fact the entire forest presents a drama in this respect. Each individual plant and each group of individuals strives for its place in the sun.

As one struggles through these forests, he will notice that the giant Douglas fir are rather few in number and there are very few young Douglas firs among the seedlings and saplings. The Western Hemlock has succeeded in usurping the

place of the Douglas fir in its chosen realm.

The reason for this is that the Douglas fir is an intolerant tree. It requires an abundance of sunlight for best growth. On the other hand the western hemlock thrives in dense shade and readily reproduces itself under those conditions. On areas recently opened by fire or some other cause the Douglas fir, because of the great vitality of its seeds, quickly begins the process of regeneration. A compact stand of Douglas firs is the result but this condition is slowly remedied as time goes on. "The survival of the fittest" is the rule, for there exists competition among these members of the same species and soon the weaker are weeded out. Species of other trees find it difficult to get established due to the competition of the very vigorous and rapidly growing Douglas

*Courtesy of the National
Park Service*

AT LONGMIRE,
WASHINGTON

The dense, humid forests of the lower elevations of Mt. Rainier National Park, are a labyrinth of botanical wealth



DEVIL'S CLUB

The spiny stems and leaves of this plant give much misery to the hiker who deserts the trails of the dense, lower forests in Mt. Rainier National Park





ANNABALIS FIR CONE DISINTEGRATING

In the late summer and early fall these cones are cut down in great numbers from the tops of the tall trees. Falling from a great height and weighing as much as two pounds apiece, they make formidable missiles, and for anyone to linger in the vicinity of a group of squirrels working the tops of these trees, is little short of hazardous

firs, but as the stand is opened up, the western hemlock, among others, manages to get a foothold. The number of western hemlocks increases with the years and there comes a time when the Douglas fir and western hemlock match each other in number and extent. From that day the reign of the Douglas fir, as the dominant tree in the forest, is ended. The tolerant hemlocks continue to re-seed and grow and thrive. The Douglas fir fails to reproduce its own kind in sufficient quantity and each year a few more old Douglas firs fall by the wayside. A high wind, a heavy snow, or merely the ravages of old age sends these forest giants to earth.

But even in defeat these trees reveal an interesting fact. When they fall, their

root system is lifted bodily from the soil, and it is then that we have cause to wonder how such a shallow root system was able to support these great trees. We often find trees up to ten feet in diameter whose roots penetrate only a few feet in the earth. They do not have a very firm footing for the simple reason that the soil is rich and moisture is abundant near the surface—hence there is no need for these trees to send their roots deep into the earth for sufficient moisture and plant food materials.

As one goes into the upper Canadian zone along the trails he will notice a distinct change in the forest. There one sees western white pine, Alaska cedar, noble fir, and similar species that have replaced the Douglas fir, western hemlock, and western red cedar of the lower elevations. This region is midway between the dense lower Canadian Zone woods and the parklike meadows of the Hudsonian



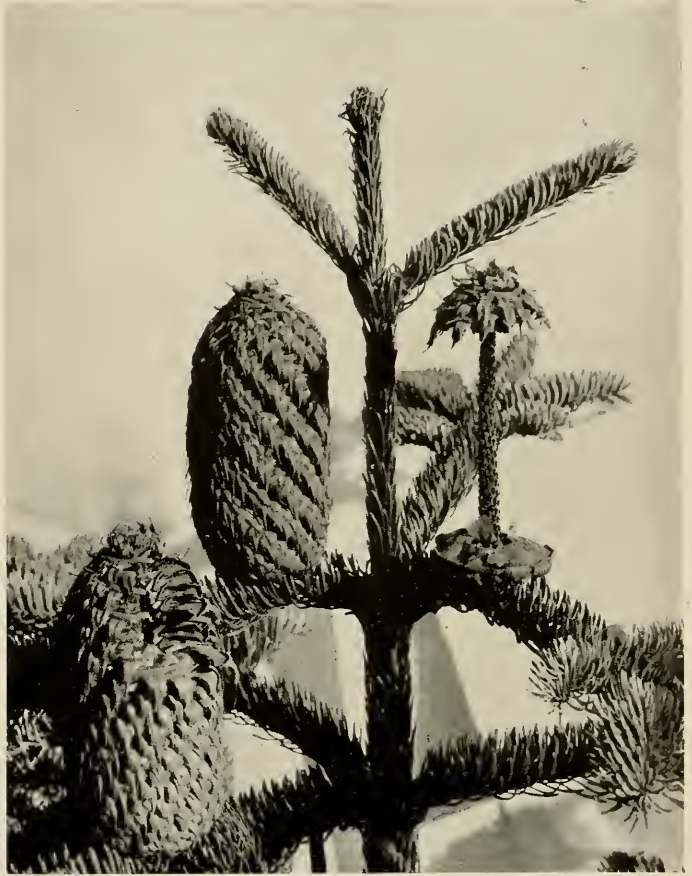
WESTERN WHITE PINE

Mature cones and foliage of the western white pine—a tree of the intermediate zones

elevations. These trees, of course, are smaller, and are generally hung with long festoons of "goat's beard moss" which in reality is a lichen. This, during dry weather, materially increases the fire hazard in these intermediate timber zones, as it dries out rapidly and offers a quick kindling torch with which to carry fire into the crowns of these trees.

And then the sub-alpine regions! Here one finds during the summer and fall a symphony of color. The flora of Mt. Rainier National Park is famous the world over not alone for the variety but also for the abundance of bloom. Alpine fir and mountain hemlock are most numerous in the sub-alpine elevations, with white barbed pine and Engelmann spruce noticeable in certain locations.

The casual visitor, seeing some artist transferring to canvas the beauty of the mountain framed with a cluster of spire-like alpine firs, rarely stops to think why those trees grow in such compact, artistic groups. Such groups are delightful to the eye and lend a texture of living things to the hard, cold, and frozen aspect of the mountain—but there is most certainly a reason for this as there is for everything else in nature. The cones of these trees mature in early autumn when the first snow flurries visit the region. As the seeds are scattered to the ground—falling from between the scales of the hemlock cones or broadcast by the dis-



NOBLE FIR

This tree of the intermediate timber types bears a truly distinctive cone. Note the one to the right which has disintegrated, leaving only the cone spike upon the branches

integration of the alpine fir cones—they do not travel far from the parent trees because the rapidly accumulating layers of snow prevent this. Spring comes, and with it the germination of these seeds—a germination that takes place on the spot where winter's snows have held them captive. Thus we find, scattered through these alpine meadows, numerous groups of trees with the older specimens in the center surrounded by their progeny of later years in gradually decreasing size to those a few inches tall.

The same species noted in the sub-alpine meadows are found at timber line. How different they appear, though!



SPRAY PARK ON THE SLOPES OF MT. RAINIER

Note the groups of Alpine fir scattered about this hudsonian meadow,—a character typical of this region from 5000 to 6500 feet above sea level

This high, rugged region has been greatly dissected by glacial action in times past and presents a variety of conditions for plant growth of all kinds. In addition, high winds, heavy snow, poor soil, and other related factors account for the slow growth, twisted and gnarled appearance, and dwarfed size of the timber line ranks. They have a picturesque grandeur that is emblematic of the rigorous nature of the "high country"—by their twisted forms they write their vigorous story upon the skyline.

It seems almost as if these trees preferred the most difficult places in which to grow. We find them upon the crests of rocky ridges where the main force of the gales that sweep down from the mountain's frigid slopes strike with greatest fury. Why do they not prefer the more

sheltered valleys just below these ridges which are more protected from the high winds? A glance at the mountain offers one clue. Bisecting the mass of glacial ice at intervals one sees narrow shoulders of black rock known as cleavers. These widen as one traces their course down the slopes of the mountain and serve to divide the great mass of ice into the present twenty-eight glaciers on Mt. Rainier. The high ridges at timber line were themselves cleavers at one time and thus represent the first land in the vicinity to emerge from the general inundation of ice that covered the greater part of this area. And so it was here that the first soil for the support of tree life at this elevation was formed.

There are other factors which probably account for the strange behavior of these

trees. While it is true that the valleys shelter one from the harsh winds, it is also true that often these valleys are colder and less inviting in temperature than is the case along the ridges. For warm air currents, rising into the colder strata, follow the crests of these ridges, while the cold air passes to lower elevations via the

valleys. It is not impossible for one to be entirely comfortable without a coat on a high ridge, even with perpetual ice close at hand, while a hike through a valley immediately below will be a chilly one in spite of the exertion of walking. Still farther one sees evidence of the destructive influence of heavy snow on every hand.



A PRECARIOUS ANCHORAGE

White-barked pine growing in a location typical of many such trees in Mt. Rainier National Park. This species is essentially a timber line inhabitant and adds much interest to this rugged region

Denuded areas through thickly timbered hillsides mark the paths of avalanches or snowslides, and everywhere one sees trees conspicuously bowed down-hill at the base—evidence of the pressure of heavy snow on these steep grades during the winter months. Under such conditions seedlings would find it impossible to get established, and, even if established, it is doubtful if they could survive the tearing action of snow pressure that would rip them from their anchorage on the slopes.

Thus the forests of Mt. Rainier National Park present an interesting and diversified story to those who care to give this

subject just a bit more than casual attention. It is not merely a story of tree identification. More nearly it is a story of plant variation and interdependence with conditions of altitude and locality. It has the esthetic quality of the beauty of forests and trees and the dramatic features of nature that are embodied in the complexity of growing, living things. Through the service of a small group of naturalists, employed by the National Park Service, the visitor to Mt. Rainier National Park is brought into intimate contact with these exceedingly interesting features of the forests of this region.



WESTERN HEMLOCK

Foliage and mature cones of the western hemlock—the most abundant tree of the lower slopes



The Scale Model of the Sable Antelope Group

TRANSPLANTING AFRICA

The Story Behind the Creation of One of the Many Groups Which Are Being Constructed for the New African Hall in the American Museum

By ALBERT E. BUTLER

Associate Chief, Department of Preparation, American Museum

THE African Hall of Mammals, which will be opened within a few months at the American Museum, has been under constant consideration ever since the late Carl Akeley's dream materialized in the miniature model which pictured a plan for procedure. That was more than twenty years ago. In October of this year, after a vast amount of study, research, and revision of plans, a few of this series of habitat groups will be completed. While the very important and necessary matter of financing such an extensive exhibit requires much time, nevertheless the planning goes on apace, and eventually the collection of the necessary specimens and material enables the sculptors and artists to proceed with the work in the Museum studios.

The years of labor since the original

conception have produced a building suitable for the housing of group exhibits, developed a definite plan and arrangement, found the necessary funds to begin the field work, and built up an organization for handling this, the greatest program of exhibits ever attempted by any museum.

To the uninitiated it would seem at this point that the way is clear for a speedy completion of the displays. The task, however, is far less simple than it seems. The collection of the specimens and material necessitates working in remote regions and under conditions often anything but favorable. The animals are picked to fit into a definite plan and not taken indiscriminately. Frequently it is necessary to search for weeks to obtain just what is wanted and even absolute



MAKING A FIELD BACKGROUND STUDY

William R. Leigh, staff artist of the Eastman-Akeley-Pomeroy African Expedition, shown here at work, made numerous paintings in the field, all of which were faithful representations of some typical African setting

failure is always a possibility. Two months or longer are sometimes required to reach the hunting ground and often weeks for moving camp if several groups are to be collected, since it is desirable to have various localities represented in the Hall.

Furthermore, there are innumerable details which must be arranged before any expedition goes into the field: equipment, supplies, passports, licenses for shooting, diplomatic contacts which will be helpful in speeding the work, traveling accommodations, and a host of other things, including the gathering of as much knowledge as possible of the country the expedition is going into and the possible conditions under which the work will have to be done. The season of the year, especially in tropical climates, is a vital consideration, since it would be impracticable if not wholly impossible to accomplish any field work during the rainy season, and the extreme dry season

finds the animals with hair in poor condition and much of the vegetation burned up with the heat.

An account of one field trip will perhaps serve to picture some of the difficulties and unforeseen situations which beset the Museum collector, and by telling the story of the problems faced and the difficulties overcome in the creation of just one of the many groups that will ultimately make up African Hall, some idea of the whole great task may be suggested.

In early 1928 I spent several months in India with Mr. Arthur S. Vernay collecting material for group settings for the Hall of Indian Mammals. Mr. Vernay had some years earlier collected several specimens of the rare giant sable in Angola, West Africa, and presented them to the Museum for use in African Hall. It was planned, therefore, that I should return from India via East Africa where I would spend several weeks in observation

over territory where several African Hall groups had been collected, and then go on to West Africa to get the necessary material for the Giant Sable Antelope Group setting. This all sounded so simple that I made little inquiry in New York before leaving, but was assured I could reach Lobito, Angola, by boat around South Africa or by motor and train across the continent from Nairobi.

I was somewhat disappointed when I failed to get any information in Bombay before leaving India, but was completely disarmed when I found upon arriving in Mombasa that no steamship or railroad agency could tell me how to reach Lobito. One transportation office told me I could get across by automobile, train, and boat, if I started immediately before the rains set in. For two reasons I couldn't do this; first, it was quite necessary that I spend a short time in East Africa as arranged, and second, such an

early departure would land me in Angola six weeks earlier than the proper season for my collecting there, provided I succeeded in getting there at all, which seemed doubtful.

I therefore booked on a steamer leaving Mombasa three weeks later bound around South Africa, in company with Mr. C. Rosenkranz, the artist, who was to make the field studies for the background of the group. At every port we inquired, hoping that we might find some definite information on boat service to Lobito, but not until we arrived at Durban were we able to get any information whatsoever. There we were told we could disembark at Loanda, two hundred miles north of Lobito, and that ten days later we would be able to catch a Portuguese freighter which would take us to our destination.

Now anybody who has had the experience even of stopping at a Portuguese



TRANSPORTING ACCESSORY MATERIAL IN NORTHERN INDIA

Ox carts are the only means of transportation in some remote parts of the country, and can be relied upon to make not more than two miles an hour



A CORNER OF THE
ACCESSORY ROOM,
DEPARTMENT OF
PREPARATION

Mr. Vincent Narahara is
shown working on several
plants for the Indian mammal
groups



PHOTOGRAPHIC STUDY OF
A REAL AFRICAN PLANT
(*Hypericum griffithii*)

Such detailed close-ups are
invaluable to the accessory
worker in reproducing flowers
in wax. An artificial bush
bearing wax reproductions of
this flower may be seen in the
illustration above

FIELD STUDY OF A SMALL
AFRICAN TREE
(*Actinodaphne*, sp.)

In the Museum laboratory
scene on the opposite page,
the wax reproduction of this
bush may be observed



CAMERA STUDY OF A
MILKWEED PLANT

This plant from Northern
India, as reproduced in wax,
is shown at the right of the
picture on the top of the
opposite page





FIELD PAINTING FOR LEOPARD GROUP
Painted by Clarence Rosenkranz in southern India in 1928

hotel in West Africa would be likely to be discouraged at this point. Happily, however, our luck was good, for when our boat arrived at Loanda, I saw a German freighter anchored in the harbor—a freighter that was two days late and bound, providentially, for Lobito.

Already our baggage had been sent ashore in expectation of a ten-day wait amid the somewhat uninviting surroundings of Loanda, but when I inquired as to the time of sailing and the destination of the freighter which was lying a mile or so away, and found that she was sailing within the hour for the very port that we were so intent on reaching, we determined to do everything we could to save that unattractive ten-day wait. It was two miles to the beach, where our baggage was already in the corrugated iron Customs House, and we had a very few minutes to reach the place before the customs officials left for the day. Luckily, however, a motor-boat was alongside the

ship on which we had arrived, and I prevailed on its crew to make their very fastest speed ashore. We arrived in the nick of time, just as the door was being closed, but by putting my foot against it and talking in my most persuasive manner, I succeeded in keeping our baggage and equipment from going into Customs for the night, and made the necessary arrangements to get ourselves and our baggage aboard the freighter, which pulled anchor just forty-five minutes after we were safely on, and landed us in Lobito two days later. Even by saving that long wait, however, thirty-seven days had passed since we had left Mombasa.

We had now reached a point from which we could carry out the purpose of the trip, but the country was strange to us and we could not plan on how much time might be required to accomplish the work. My first concern was to learn how and when we could get away from this ap-

parently isolated spot and how much time we would have for the task in hand. I learned from the steamship agency that the next Europe-bound boat, one month later, stopped at Lobito, and if we missed this we must wait two months longer for the next. There was, therefore, no choice but to book passage on the next boat and trust to luck that we could cover the work required and get back within the month.

At this time two trains a week were running inland for about 375 miles and we had two days to wait for the first train. During this wait I had to inform myself on many points, make arrangements for such assistance as we would require, and plan for an expedition through country we had never visited before with less information at our disposal than we could well have used. We were met by an automobile at the end of the railroad journey, for that much could be arranged by wire. Next we were driven 175 miles

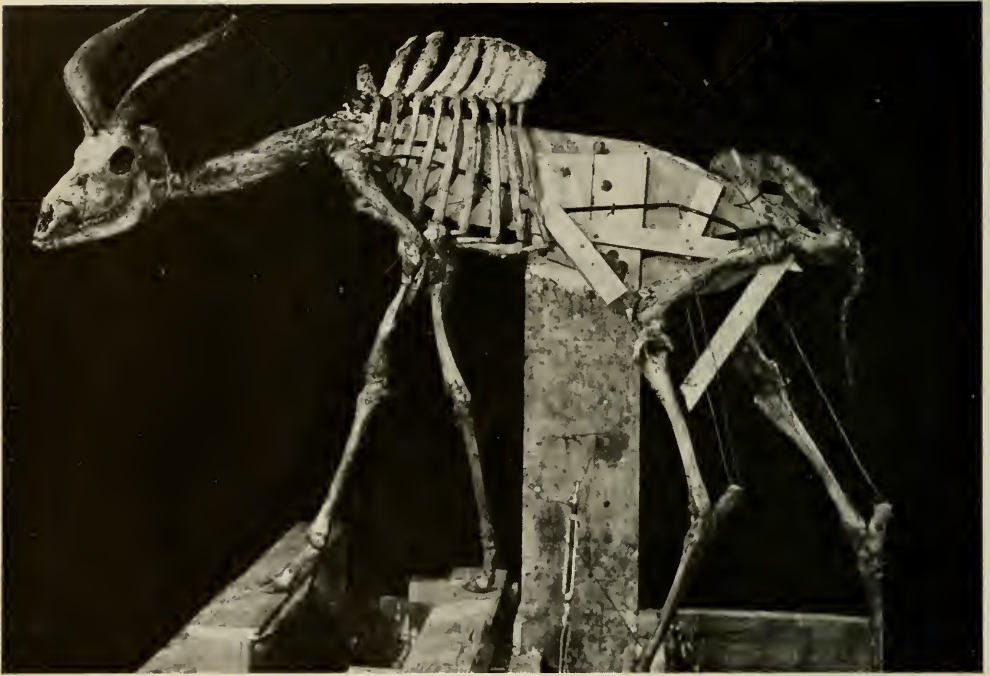
to a railroad construction camp, only to learn that no boys were available for our safari. After much discussion it suddenly occurred to one of the white men at the camp that on the preceding day a number of black boys had been sent to the "bush" to work out unpaid taxes; a telegram brought the reply that fifteen of these boys could be sent back next day.

The boys arrived as scheduled, and in two days, with each boy carrying a sixty-pound load and covering about fifteen miles each day, we reached the country where Mr. Vernay had collected the sable antelopes. The number of boys is determined by the amount of equipment and the duration of the trip, and, in addition, there are always a head boy and a cook. In this case we expected to be in camp a maximum of two weeks. Our equipment, plus two week's food supply for the boys, figured approximately nine hundred pounds, or fifteen carrier boys.



INDIAN LEOPARD GROUP IN THE AMERICAN MUSEUM

Note how closely Mr. Rozenkranz's field sketch study shown on the opposite page was followed in the completed Museum group



THE FIRST STEP IN MOUNTING A LARGE MAMMAL

The skeleton, in this case a greater kudu, is placed to express the action which is to be shown in the finished animal, and gives its exact proportions

Fortunately no further obstacles of consequence appeared to delay our work in Angola, and the trip inland, more than five hundred miles by train, automobile, and safari, was completed, and we returned to the coast in time to catch the north-bound boat one month later.

The field work in this case was along what might be termed normal lines. The first two days were spent in company with Mr. Rosenkranz, going over the surrounding country to agree upon the most typical and picturesque setting. This done, Mr. Rosenkranz set about painting the background study while I studied the plant forms and general details of the landscape. The selection of plants to be shown in the group setting is made by first determining which are the most common and then taking those which lend themselves best to the methods of reproduction.

Plaster molds are made from the fresh

leaves of each plant or tree as well as of flower petals. A duplicate series of leaves, whole plants, and small branches are placed in a tank of weak formalin solution which preserves them in their natural form indefinitely. Color notes of all these as well as other material are recorded. Grass is cut at the roots, carefully packed in bundles, and strapped to a board or stiff bark to prevent breakage. Samples of the bark and rocks are taken, and sufficient silt, dry leaves, etc., from the ground surface fully to cover the group floor. Moss is packed quite solid, since its spongelike character makes it revive quickly in water and it is then easily preserved. Photographs are very important and a complete record of every detail is made with notes to go with each of the many negatives. The field work proper was completed in twelve days, but the time elapsed from leaving Mombasa to sailing north from Lobito was sixty-



THE MODEL COMPLETED IN CLAY

The skeleton armature has been covered with clay and modeled according to the measurements of the animal as collected in the field



THE COMPLETED SPECIMEN

A light mannikin has been made from a mold taken from the clay model shown above. The skin is mounted on this shell, which is both strong and durable. This specimen, which was mounted by R. H. Rockwell, is now ready to take its place in the kudu group in the African Hall

eight days, and we had traveled about seven thousand miles! The trip from Lobito to New York, of course, added four more weeks, but finally our data and our collections were unpacked at the Museum. The material which had been collected was examined immediately and given the necessary care to insure its permanency, whereupon the next steps in the preparation of the group were planned.

A small working model, based upon material collected and field observations, was next set up and, upon being approved by the Curator of Mammals, this became the guide for building the large group. The model was very carefully constructed with regard to accurate scale in every detail, including the plant and tree forms, the rocks and grass, and, finally, the animals themselves.

With this much behind us, work on the actual group began.

The mounting of the animals is done with infinite care and consideration for the character of each. Not only the skin of the animal to be mounted is taken, but the entire skeleton as well, together with many measurements, photographs, and plaster casts. The skeleton is set up in action corresponding to that suggested in the small model. This is strengthened so that it will support the clay body which is to be modeled over it. By using the information imparted by the measurements, photographs, etc., the sculptor taxidermist, through his keen knowledge of animals, is able to reproduce a faithful likeness of each individual creature that is to be mounted. When the clay model is complete, the task of the taxidermist is but half done, for from this model a plaster mold is made, and into this mold a very light and durable manikin is built of papier maché, wire screen, and wood.



ACTIVITY IN THE AFRICAN HALL

Many and varied are the operations which must be carried on simultaneously in constructing a new museum hall. Carpenters and mechanics are building cases, and as fast as these are completed, the department of preparation is installing groups

The tanned skin is secured to this manikin and the finishing touches are then added.

This operation required, for each animal, the equivalent of one man's time for more than two months, and is to be multiplied by five in the case of the Sable Antelope Group, since there are five animals that have been mounted.

During this time the artist has been engaged in painting the background from his studies made in the field, and the so-called accessory workers have been preparing the setting with its trees, foliage, rock-work, grasses, etc. The latter work calls for tremendous detail and is often so exacting and elaborate as to require more time for reproduction than all of the other group operations together.

In the Giant Sable Antelope Group that I am attempting to describe there was a fairly even distribution of work between the creating of the setting and the mounting of the five animals with the painting of the background. This group called for the reproduction of two large branches of an acacia tree, which required about five hundred compound leaves, or ten thousand leaflets. In addition a small tree of the same kind was made, with half that number of leaves. Two other small trees were made, each with about five hundred simple leaves. Several small shrubs were created in addition to two flowering plants and an orchid. Besides these, the large tree trunk had to be reproduced from photographs and a



PUTTING FINISHING TOUCHES ON A BACKGROUND
The canvases required in the African Hall groups are approximately 18 feet high by 45 feet long

sample of the bark, and a mass of grass that had been preserved was now colored. Such work is not done in the familiar "world fair" manner, which aims at effect rather than accuracy of detail and is made to stand for only a short time, but it is built faithfully and to endure. Each leaf is reproduced from a mold pattern either in wax, celluloid, or paper, and the whole is assembled true to the form it represents. This alone, in the case of the Sable Antelope Group, meant many months of work for several men.

Each step in the assembling of the group had to take into consideration the whole plan so that no damage would occur, particularly to the setting which is most subject to breakage or injury.

While all this work was being done, the

great alcove in which the group is permanently to appear, was being built. The lighting arrangements had been installed and all preparations were made ready for the sealing of the group immediately upon its completion so that no dust may mar the setting, for these exhibits are built to stand for many generations. As a further protection against deterioration, the lighting pocket is so ventilated as to carry off the heat, and a "breather" tube loosely filled with cotton is installed near the base of the group to take care of any expansion or contraction due to temperature changes which might otherwise cause cracks to develop and dust to enter the group enclosure.

To the person visiting African Hall at the time this article is being written, little of all this work is in evidence. The alcove is finished. The background painting is complete, but there are few

other indications that will give the uninitiated any idea of what the completed group will look like. Yet even up to now, with the final installation of the group still in the future, thousands of essential tasks have been performed and months of work on the part of many men have been completed. The end, for this group, at any rate, is now plainly in sight.

It has been my purpose, in giving these few details of the Sable Antelope Group, to attempt to show a little of the tremendous task that has faced us in the preparation of African Hall. Each of the other groups will require the same intricate care from many hands, and when it is realized that I have told of only one out of twenty-eight large groups, we hope the visitor may, through this simple account, be able better to appreciate their value and better to enjoy the exhibits when finally they are open to the public.





CONFIDENCE

PETER POSES

Ways of a Trailside Flicker

By WILLIAM H. CARR

Assistant Curator, Department of Education, American Museum

PHOTOGRAPHS BY THANE BIERWERT

THE law of average, applied to wild animal collecting, is one of the few unwritten statutes that proves its worth in actual practice. We are led to believe this whenever someone presents us with a likeable, playful, infant raccoon, a noisy but promising baby crow, a powerful five-foot rattlesnake, or an especially tame young beaver or squirrel. The Bear Mountain Trailside Museum, as the years go by, receives increasing numbers of wild creatures, from tiny insects to large four-footed animals. Although we collect many of our own specimens, we also accept gifts from men, women, and children, from a radius of twenty-five or thirty miles of our museum building. In providing homes for waifs of endless variety, we naturally expect to have adventures both pleasant and unpleasant. Seldom are we disappointed in either result.

Last year was turtle year. It would have taken considerable bookkeeping to

record the number of different turtles given us by friendly persons who wanted to add to the population of our already overcrowded turtle pools. We invariably accepted the recruits, protesting or stolid as the case might be, and either sent them to others who needed turtles for exhibit, or else walked to some near-by pond and released the stumpy-legged reptiles with the hope that they would not be re-discovered and returned by overzealous "helpers." But this narrative is not about turtles!

Sometimes we were tempted to reject other types of gifts, due to overcrowded facilities in our Trailside Zoo. This was our first impulse when, on returning to the Trailside Craftshop one warm, late spring day, we discovered a pair of very young flickers, or high-hole woodpeckers, huddled in the bottom of a temporary cage.

One of the most distressing features of our duties on reception committees for



PETER AND HIS BROTHER

The young flickers were ever alert and watchful. Their glistening, sharp eyes could never have been called "beady," for the "expression" of a bead is never intelligent!

newly arrived animal boarders, is the all too frequent encounter with unfortunate baby birds taken from their warm nests by well intentioned but miserably misguided children and grown-ups who believe themselves to be rendering us a service. We have discouraged this practice with all the emphasis and strength at our command and, although the number of cases of nest-robbing has dropped noticeably, a few young birds come to us each season, nevertheless. Whenever possible, we insist that the would-be donors return at once to the scene of their depredation and place the stolen fledglings where they belong, under the continued guidance of their rightful parents.

Therefore, on viewing the disconsolate young woodpeckers, our first question was, "Who brought these birds in?"

It was soon apparent that the unknown "collectors" had vanished, literally leaving their basket on our doorstep. There

wasn't any way of learning where the nest hole was, and thus we were faced with the important problem of "to keep or not to keep." Our principal dilemma, as usual, was food.

We decided at once that if the little high-holes would accept nourishment, all would be well. We permitted the orphans to rest for several hours, and then experimented with our standard bird food, used for many different species of birds. It was composed of ants' eggs, some grain, and bits of meat. The trade name was "mockingbird food." A small stick was whittled carefully until a thin spatulate end was formed. The "mockingbird food" was then moistened, placed upon the wood and inserted in the flicker's red mouth. After a number of negative results, and much consequent loss of food, the babies finally agreed to meet us half way, and from then on it was not a matter of "how to feed," but "how often"!

Two days or so after their capture, the flickers were at home with us. Their loud, incessant demands for food could not be mistaken for any other sign. Whenever anyone passed their cage, the birds would fairly shout for attention, and could be stilled in only one way—by appeasing their exceedingly healthy appetites. Were they worth all the trouble? Certainly! We were amply repaid for any effort on our part and, before our season of operation was over, we would not have traded the flickers for a dozen parrots or two dozen canaries—better make it two hundred canaries!

The flickers were clean little fellows and were decidedly individual in their outlook on life,—if they had an outlook. Both grew to be pugnacious to such a degree that it was necessary to separate them in the interest of live and let live. They were true to their woodpecker instincts, from the very first. Their

favorite sleeping position, for instance, was a vertical one, with two toes above and two below, widely spread and firmly clasped to the wire, and heads turned almost completely backward, with long bills thrust between folded wings. There was one other feature about their sleeping habits that was a mystery for nearly a week.

One of the men slept in the workshop, with windows open, not more than five feet from the flickers. At an equal distance away, on the other side of the building, were two young skunks, named Sachet the Fifth and Sachet the Sixth respectively, also in an elevated cage but around the corner from the woodpeckers. The man's habit, as a rule, was to retire late each night, and frequently to read in bed afterward. On several different occasions, on the following mornings, he reported that the skunks, which were active during a greater portion of



THE WOODEN "BEAK"

The flickers became so dependent upon this method of feeding that it was very difficult to "wean" them. It was midsummer before they learned to secure food for themselves



MUTUAL INVESTIGATION

Jim, the crow, ducks his head rapidly as Peter advances

the night, uttered loud, high-pitched "whistles," that reminded him of sounds made by penny whistles. We were all well acquainted with the squeals and squeaks that young skunks frequently utter when rough and tumble play results in a pitched battle and when "mouthings" turn to "bitings." The new and unexpected skunk "voice" was strange.

One evening the mystery was solved. Several of us were talking near the flicker cage when the "whistle" was repeated. The skunks were just waking up for their evening meal and the birds were fast asleep. To our astonishment, the flickers proved to be the whistlers, for on close observation we found that the shrill sounds issued, at first, from the woodpecker we had named "Peter." His breathing and that of his brother was heavy and regular, and every so often, for a reason we were unable to discover, he would whistle with every other expelled breath. The sound suggested that Peter might have had the asthma. We listened very attentively for a long time and presently Peter's brother joined in the chorus. His whistle, as my notes reveal, was in a distinctly minor, mournful key

and was not so often repeated. It had a ventriloquial effect. This nocturnal duet was continued for about ten days. We never heard it after that. We would be very glad to learn of similar records. What a weird sound it would be in the woods at night! Perhaps the mocking-bird food was responsible!

Jim, the ever inquisitive tame crow, was an interested onlooker during the



JIM WATCHES

Peter takes a sun bath with the crow looking on

days of the woodpecker's early training. He would hop up upon their cages, cock his head first on one side and then the other, as though to say, "What on earth have they brought in now?"

Peter's brother never had a name and for some unknown reason, maybe due to an inferiority complex because of his nameless state, was desperately frightened whenever Jim came near. Peter was frightened not at all. On the contrary, he did his best to attack and, in his turn, to frighten the crow!

The two birds would call "*wick-up, wick-up, wick-up*," vigorously, over and over again when excited or when handled.

Often we would remove the birds from the cage and permit them to hop about

and cling to tree trunks where their exploring, long tongues penetrated cracks and crannies in search of food, which had seemingly been previously garnered by downy woodpeckers and other free, wild birds. It was a strange sensation to have Peter perch upon one's collar and use that same long tongue, to examine one's neck and ears. To say that it "tickled" is to say nothing! The pink tongue that showed tiny barbs beneath a magnifying glass, flashed in and out like a miniature, soft pointed sword that could be sheathed and unsheathed with incredible rapidity of motion. Like the wings of a hovering humming bird, the flicker's tongue was practically invisible; so swiftly did it dart back and forth.



YOUTH AND AGE

Jim is two years old and Woodpecker Peter is two months old

Still more disturbing to one's nerves were the times when Peter decided to use his sharp bill instead of his tongue upon one's neck or hand! Usually this experience occurred but once to each human individual, who thereafter took steps to insure against its recurrence. As one visitor remarked, this habit, based upon the flicker's known penchant for attacking wood, was not at all complimentary when

the assault was made upon one's head! Later in the season, when Peter was given his freedom to come and go as he pleased, he would often fly down and alight upon someone's head without the slightest warning as to his intentions. Thus the remark was applicable to more than one occasion and to many individuals.

We hesitated a bit before permitting the bright-eyed woodpecker to fly when and where it pleased. Peter's brother died meanwhile from a malady unknown. We had become much attached to Peter, and on the other hand, he was still dependent upon our food. We feared that the bird would disappear if left entirely to its own devices. But our doubts were groundless. Peter never strayed far, and would usually come when we whistled to be fed and cared for. On many occasions when we would sit beneath the trees, he would fly to us and remain close by until we moved, but, unlike the crow, he did not appreciate having his head scratched. He sought company but not familiarity. If the truth were known, I fear that the mockingbird food was in the back of his mind on these occasions, for he would fly to the table where the food was



TURNING AWAY

The interview ended, Jim, preserving his dignity, stalks away



TONGUE FEEDING

Peter's tongue was so rapid that the camera failed to catch it, as it darted toward the food on the tree trunk



A FAVORITE PERCH

The young flicker showed utter fearlessness of those who cared for him. He would ride about on one's shoulder whenever this favor was granted





IN THE DOORWAY

The flicker surveys the scene from his tree trunk "home." Although kept temporarily in a wire cage, the bird accepted this natural retreat without hesitation



"WICK-UP, WICK-UP
WICK-UP!"

The flicker's call was exactly like that of his wild relations. Note the typical woodpecker toe-hold here

kept, and call loudly until someone fed him.

Intelligent? Of course he was!

When we sat upon the fence rail, near the turtle pools, Peter would fly down from a near-by tree and come hopping along sidewise uttering a soft *chit, chit, chit*, as he advanced, until he could get no closer, and then, if his "chittings" failed to attract any attention, he would fly upon my shoulder. If even this act was not acknowledged, he would begin to "wick-up" right in my ear. Have you ever had a flicker "wick-upping" in your ear? It is an ear-splitting affair, I can assure you! I invariably reached up, took him upon my hand, walked over to the feeding table, and applied the wooden "beak." When his hunger was appeased Peter would fly off for a time.

Visitors, young and old, were delighted with the friendly flicker. They would sit and watch him for hours, and he would respond by staying about where his antics could be viewed to good advantage. Jim, the crow, could easily have been jealous of all the attention showered upon his neighbor. Perhaps he was! Nevertheless, he never annoyed or attacked the smaller bird. He kept his distance and his dignity at the same time.

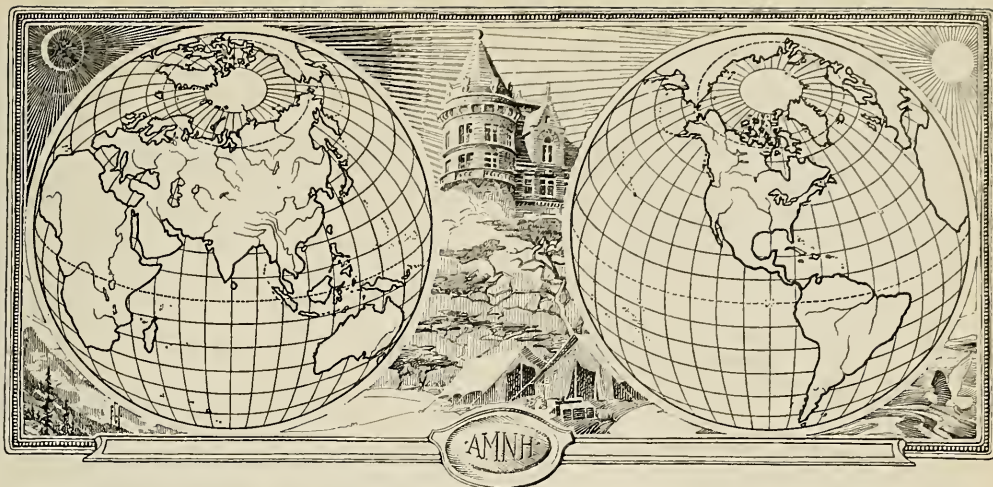
The flicker's presence, by the way, was of interest to wild-folk as well as humans who entered his bailiwick. His "wick-ups" sometimes attracted older wild flickers. Especially was this true in the early morning. One day, when the young bird was in his cage, an adult flicker flew over from the woods, perched upon the roof, and was seen to peer inquiringly over the eaves. The boys fondly believed

that this was Peter's mother, for she came on several occasions. It seems a pity to destroy so touching a possibility, but we are certain that it was just a case of over-worked imagination—and yet!

Gradually Peter learned to secure food from the ground and from tree trunks. He searched for grubs and other insect forms and his beak became more proficient in tapping the various sources of supply. His tattoo rang out with increasing vigor and we hoped that eventually he would become independent and revert entirely to the call of the woods and fields.

Daniel Carter Beard, the "Dan Beard" of woodcraft and Boy Scout fame, who told us that his first flicker observations had been made before the Civil War, one day came to visit the Trailside Museum. No sooner had he rounded the Trailside Craftshop corner, than Peter sailed down and perched confidently upon the Commissioner's shoulder as though greeting a long lost friend. Instantly Uncle Dan was charmed. He could not have enough of the flicker. So Peter, some five months old, rode about on the shoulder of a man who had passed four score years. It was a picture that we will long remember.

The upshot of the mutual and instant friendship was that Uncle Dan eventually won Peter for his own. We sent the bird to him, and then, after a short time, it did at last seek the open, for winter was coming and it was time for all good flickers to be on their way. If the same "law of average" ever brings us another "Peter," we shall rejoice exceedingly, but surely this is too much to expect!



SCIENCE IN FIELD AND LABORATORY

American Museum Activities—Conservation—Education—Meetings
of Societies—New Publications

EDITED BY A. KATHERINE BERGER

BIRDS

EXHIBIT OF BIRDS IN ART.—In connection with the Fiftieth Anniversary Meeting of the American Ornithologists' Union, which will be held in New York during the week of November 13, 1933, an exhibition illustrating birds in art will be displayed in Education Hall of the American Museum of Natural History from November 7 to 27.

The works will include paintings, drawings, prints, sculpture, and enlarged photographs of birds. All persons are invited to contribute examples of their work. Full power of decision regarding the installation of exhibits, however, will rest with the committee, which may limit the number of works of any individual as seems expedient. In general, representations of birds in a natural environment, or of living birds used in decorative design, will be given precedence over those of dead birds.

Persons wishing to take part in the exhibit should communicate with Mr. Courtenay Brandreth, chairman of the committee in charge, who may be addressed in care of the American Museum.

BIRD BOOK FOR THE BLIND.—The Library of Congress, working in coöperation with the American Red Cross, is putting into Braille type the *Handbook of Birds of Eastern North America*, by Dr. Frank M. Chapman.

CONSERVATION

FEDERAL RELIEF PROGRAM BENEFITS WATERFOWL.—Birds, as well as man and the

forests, are benefiting by the Federal unemployment relief program, according to Paul G. Redington, chief of the Bureau of Biological Survey, United States Department of Agriculture.

Three camps of the Civilian Conservation Corps, he explains, are improving refuges established and maintained by the Federal Government for the protection of birds. One of these, the Blackwater Migratory Bird Refuge, near Cambridge, Maryland, is a breeding ground for black ducks and blue-winged teal. Mallards and pintails also concentrate on the Blackwater marshes during the migration season, and many shore birds find sanctuary there. The other two refuges now being improved by the Conservation Corps are used by the birds principally during migration and in the winter season—Swanquarter Migratory Bird Refuge, in North Carolina, a notable resting ground for wild fowl, including swans, and St. Marks Migratory Bird Refuge, in Florida, an area frequented by Canada geese, ducks, sanderlings, and other shore birds. St. Marks refuge comprises 19,403 acres; Swanquarter 8,803; and Blackwater, 7,651 acres, and all were established under the terms of the Migratory Bird Conservation Act in furtherance of treaty obligations for the protection of birds that migrate between the United States and Canada.

EDUCATION

TRAILSIDE NOTES.—Several new features have been added to the American Museum's new Trailside Museum entrance area at Bear Mountain, New York. Six mammal cages have

been built near the Historical Trail. A large trough, with running water, simulates a brook and runs through each cage. The New York State Department of Conservation has completed the installation of a State Demonstration Tree Nursery, with 24,000 three-year-old evergreens of seven species. This demonstration is near the Historical Trail area, and may be viewed from the Bear Mountain Bridge.

A new deer pen has also been erected near the Snake Pit. Three Virginia deer fawns are exhibited here. The Trailside Geology Museum is equipped with cases and the installation of exhibits is well under way.

Attendance to July 15th shows marked increase over previous years. This is largely due to the new and attractive entrance and parking space, the concentration of all exhibits, and the other improvements made possible by the Commissioners of the Palisades Interstate Park.

FISHES

NEW MODELS OF DEEP-SEA ANGLERS.—Six life-like models of weird monsters that live far below the surface of the sea have recently been added to the exhibit of deep-sea anglers in the American Museum of Natural History.

The models of these ceratioids or deep-sea anglers were received in exchange from the British Museum (Natural History). They are enlarged copies of originals studied by Dr. C. Tate Regan and his collaborator Miss Trewavas and described in their monographs on the Ceratioids of the "Dana" Expedition, sent out by the Carlsberg Foundation of Copenhagen. The fish themselves were caught in Atlantic and Caribbean waters.

Black as jet, with enormous mouths bristling with long, needle-like teeth, these amazing beings might well be described as living fish-traps. To lure their victims to them through the ink-black darkness of the deep, they are equipped with phosphorescent organs that glow in the darkness.

Among the strangest of these is the *Photocorynus spiniceps*—one of the several species that have developed parasitic males. Many times smaller than their relatively huge females, these tiny males cling to the females and, in time, become permanent and insignificant appendages of them.

In this odd scheme for living in the great deeps, several males have occasionally been found attached to one female, but in the model just received only one male is shown. As it happens he hangs on for dear life above his mate's right eye, close to, but safe from, her cavernous mouth with its rows of needle-like teeth.

Little is known about the courtship of these

fantastic beings, but it may be that, strictly speaking, there is no courtship at all, and that the tiny males, attracted by the powerful phosphorescent lure of the relatively gigantic females, rush toward the light; but usually they rush to their doom, because the glow that attracts them is not a lure but a trap—and all is food that comes into the female's mouth. It may be imagined that one male, more lucky than the rest, may have escaped the snap of her great jaws by snatching at and hanging on to her cheeks or throat.

The male's sharp little teeth then pierce the female's skin and soon he begins to feed upon the blood of his huge mate. As he hangs on with bull-dog grip, the male is gradually transformed into a quasi-parasite and becomes attached to her for life, or at least for long periods.

The tentative explanation for this strange state, approaching semiparasitism on the part of the male, is that it is Nature's way of insuring the perpetuation of the species, since, before this happy solution of the problem, the chances of a lone wandering female angler finding a mate in the vast black spaces of the great deep were slim enough. But one naturally wonders why such a meek and inoffensive little male fish should ever become ambitious and rash enough to press his unwelcome attentions upon a giantess of such frigid and ferocious mien. The simpler explanation would seem to be that the little males are merely attracted by the light and that only one of them occasionally escapes being devoured by the huge female.

Another interesting deep-sea angler also comes from the Caribbean Sea. This fish is an angler indeed, as it is equipped with rod, line, hook and bait. The rod sticks out from its snout. From its tip hangs a line several times longer than the fish itself, and at the end of the line dangle three sharp hooks and a luminous lure. This fisherman-fish probably jerks the rod and dangles the bait in front of its victims, since it is provided with relatively strong muscles for moving its rod and line.

Still another fish has a long, luminous "beard"; the "nose" of another ends in a long line equipped with a luminous bait. These are only a few of the ways in which the various anglers lure their prey within striking distance.

To the student of evolution the angler fishes are of special interest because, when we compare them with other related fishes, we can see many successive stages in the specialization of their peculiar features. The lure or illicium, for example, has been made out of the front part of the dorsal fin. In *Branchionichthys unipinnis*, the most primitive living member of the order of

pediculates, to which the anglers belong, the future illicium is represented by the first ray of the dorsal fin, the latter being extended forward on top of the head. In the goosefish, the skin at the top of several of the rays of the dorsal fin is produced into little flaps. In the deep-sea anglers the flap on the first dorsal ray has become modified into the lure. Of course we do not know how a luminous organ began at this one spot, but we do know that luminous organs are developed almost anywhere on the skin of various deep-sea fishes, and that there are many

gradations from a thickened scale which produces a glowing mucous substance to the bulblike and branched lures of the anglers. The "rod" of the illicium is simply the shaft of the first ray of the dorsal fin. The muscles that move the "rod" are evidently enlarged from the usual muscles that raise or lower the fins of ordinary fishes. Finally the cavernous trap of the anglers is merely an enlargement of the jaws and throat of such an ordinary fish as a bass.—W. K. G.

RAINS OF FISHES.—Readers of *Natural History* will recall in former issues articles by Dr. E. W. Gudger presenting authentic records about rains of fishes that have occurred in various parts of the world. Every once in a while Doctor Gudger receives word of fresh instances of these phenomena. The following contribution is of sufficient interest to warrant its publication:

A RAIN OF FISHES IN CRISTOBAL, CANAL ZONE

Stories of fish rains, like many other fish stories, usually stimulate the average person's bump of skepticism. In spite of all the logical explanations it is somewhat of a strain on the imagination to draw a mental picture of fishes coming from the air, but "seeing is believing," and I consider myself fortunate in having been able to observe this phenomenon.

Before going into the discussion of this fish rain, it might be well to mention our location. New Cristobal is built on a small peninsula. At a distance of about two miles northeast of us, across Manzanillo Bay, is the submarine and naval air base of Coco Solo. Across Limon Bay to the west at a distance of about five miles is Fort Sherman, which is also on a peninsula. On

December 1, 1932, during a torrential rain accompanied by heavy north winds blowing off the Caribbean Sea, small fish were seen in the streets at all these points. From a comparison of the

specimens it appears that the same species of fish fell in all three places. The residents in these locations had never seen fish in their streets before, although the sewers are flooded every year during the heavy rains of the wet season.

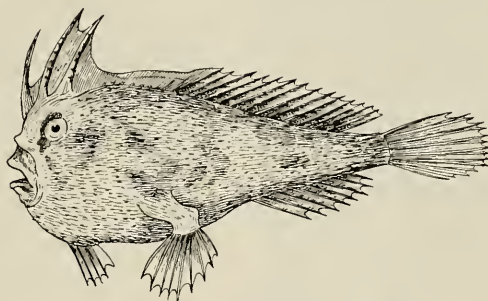
In New Cristobal the water in the streets usually gets several inches deep during a heavy rain. It was after one of these down-

pours that the people were surprised to see in the gutters small fish trying to find deep enough pools in which to hide. The next day I counted dozens of fish that had survived in pools in the street gutters that were not completely drained. I also counted several hundred fish in a large cement horse-watering tank. This tank has an overflow so that the fish might possibly have entered from the sewer, but only by passing seven or eight feet up a vertical two-inch pipe. Any fish entering the tank in this manner would have to climb, as there is not sufficient overflow water to enable one to swim. The fishes in question do not seem to be capable of making such a climb.

A Spanish girl, Grace Bejarano, who lives in New Cristobal, brought me some fish that her little sister had caught on the lawn. Bejarano's colored maid had forgotten a sheet which was left spread on the grass during the rain. The little sister caught most of the fish on this sheet. Several people in their neighborhood who owned aquariums paid the small boys five cents a dozen for catching these fish. Many other live specimens were brought to school by students.

About a week after the shower a boy named Peter Ender was playing near a church in New Cristobal. Passing a barrel which stood under the eaves, he noticed small fish jumping out of the water. He looked in the barrel and found that it contained many little fish. A large area of the roof drained into the barrel, which when full, overflowed on to the grass. Hence the only way fish could get into the barrel would be from the roof or for some one who had caught them elsewhere to put them there.

At Fort Sherman the officers' quarters are



BRANCHIONICHTHYS UNIPINNIS

A primitive pediculate, described by Cuvier, in which the lure of the anglers is represented by the first ray of the dorsal fin



FISH THAT FELL FROM THE SKY

A photograph of the gobies in various positions. Note the ventral sucker between the pectoral fins, by which they climb

built on a hill which rises abruptly from the sea-shore. On this hill is an officers' tennis court upon which many small fish were seen swimming after the rain. In fact, fish could be caught ten days later in a pool in a clogged gutter at the edge of the court. Some of these fish were brought to school by Captain Vane's daughter, Marjorie.

Last but probably the most impressive is the story of Barbara Mathews from Coco Solo. She lives on the second floor in the government quarters, and was watching the rain fall on a piece of roof that projected out beneath the window. She suddenly became aware that small dark objects were striking the roof, but the rain was falling so fast that she could not tell what they were. Barbara had seen enough to make her curious, so as soon as the rain stopped she went down the stairs and found that the pools under the eaves contained dozens of small fish. Some of them had been killed, but there were enough live ones so that the children immediately went fishing on the lawn.

Upon observation these fish were found to be a fresh-water variety inhabiting the coastal rivers that flow into the sea. Specimens placed in salt water appeared to be dehydrated by the action of the salt water. At least their bodies shrivelled to a mere skeleton in a few days and the fish died. When sea water was diluted with equal parts of fresh water, the fish did not appear to be affected.

The ability of these fish to climb was rather unusual. By means of modified pelvic fins used as suckers, the fish attached themselves firmly to near-by objects. It was found very difficult to pour the water and fish from one jar into another,

for they all proceeded to cling firmly to the sides and bottom of the jar. Some of the specimens clung so firmly that they were injured when removed.

Another characteristic that adds to its climbing ability is the fact that the fish can stay out of water for quite a period of time. When disturbed, the fish will leave the water and by a snakelike crawling action of its body go up the side of the vessel for three or four inches and cling there. Many tests were made to determine the length of time the fish would voluntarily stay in the air. The longest time recorded by a stop watch was twenty-six minutes. At the end of this period the fish entered the water and swam about, showing absolutely no signs of exhaustion.

All the sewers in New Cristobal empty into the sea, so even though we assume that these fresh-water fish did climb or swim from the salt-water sewers into the streets, and that small boys caught and put them into near-by tanks and barrels, it would be difficult to explain how they climbed up the hill at Fort Sherman and got on to the tennis court; or how they arrived on top of a sheet on the lawn at New Cristobal; and most difficult of all, how they slid from the roof to the lawn in Coco Solo, without our coming to the conclusion that they had fallen from the clouds with the rain.

Specimens of the fish in question have been identified at the American Museum of Natural History in New York City, as the fresh-water goby, *Sicydium salvini* Grant.

K. W. VINTON, Science Instructor,
Cristobal High School, Cristobal, C. Z.

FOSSIL VERTEBRATES

FIELD WORK IN THE WEST.—On August 1st Mr. Barnum Brown left New York for Montana and Wyoming to continue exploration in the Lower Cretaceous beds of those states, especially on the Crow Indian Reservation in Montana.

This is the third season devoted to this field. In 1931 and 1932 twelve dinosaur skeletons were excavated and two large Sauropod skeletons were discovered, partly explored and re-covered, near Graybull, Wyoming, in the Bighorn Basin. These two skeletons are covered by ten feet of sandstone which Mr. Brown plans to remove over an area of 65×45 feet, but the skeletons will not be removed this year.

It is planned to have three local men with two teams, plows, and scrapers to remove the sandstone, which in part will have to be shot off with dynamite or black powder. After this heavy work is completed the skeletons will be re-covered sufficiently with clay to protect them during the winter.

At the end of the season Mr. Brown plans to retrace all of the Lower Cretaceous beds around the Big Horn Mountains worked in previous years and make a reconnaissance to the Black Hills to check and establish the relationship of the Lower Cretaceous beds in that region.

Previous to the American Museum expeditions in the Lower Cretaceous deposits, dinosaur remains were known only from fragments rather than skeletons. The work will not only make a great addition to the exhibition halls of the American Museum, but will enable us to establish the range variation and development of Cretaceous groups that originated in Lower Cretaceous times and continued on up through to the close of the Cretaceous—a period of 60,000,000 years. This will give the American Museum the most comprehensive collection of Cretaceous dinosaurs of any institution in the world.

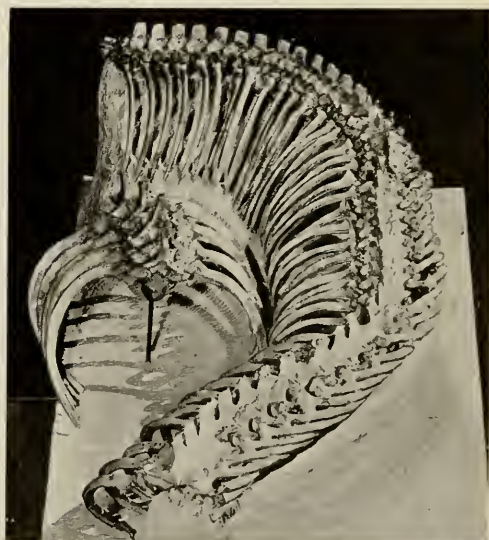
A GIGANTIC FOSSIL SNAKE.—There have just been mounted and placed on exhibition in the American Museum the fossilized bones of one of the largest snakes that ever lived. This specimen, one of the prizes of the Scarritt Patagonian Expedition, was found on January 17, 1931, by the leader of the expedition. It was one of many fossils found in Cañadón Vaca ("Cow Canyon"), near the center of Patagonia, in the southern part of Chubut Territory, Argentina.

After days of hard labor, the block of rock containing the specimen was cut out of the cliff in which it occurred and encased in protecting bandages with strengthening wooden splints. It was then lowered by ropes and carried by hand to the edge of the broken land at the foot of the cliff, then carried on horseback to the nearest

point to which a car could be driven. Later it was taken by motor truck to Comodoro Rivadavia, chief seaport of this part of Patagonia, where it was packed in a strong box. Hence it was transported to Buenos Aires, and in June, 1932, it was shipped to New York.

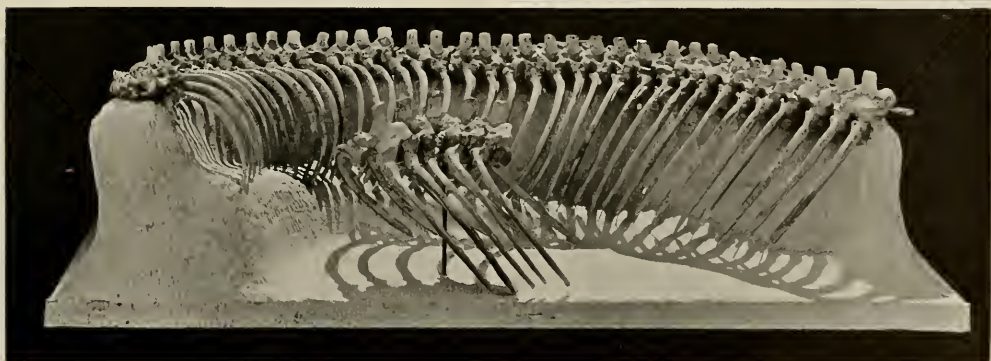
In New York it has taken a year to finish the work on this specimen. Each bone had to be carefully freed from the rock in which it was embedded, then to be soaked in shellac and to have missing fragments restored with plaster. The parts are so fragile that they had to be supported and reinforced by numerous wires and iron rods. As soon as the bones had been cleaned drawings were made of them by an artist and a thorough scientific study of them was made. A technical paper on them was written and recently appeared in the *Bulletin of the Museum*. Finally the parts were reassembled, mounted as they now appear, and placed on exhibition.

This snake lived in the Eocene Epoch, probably about 45 000 000 years ago. The rock in



MOUNTED FOSSIL BONES OF AN EXTINCT
GIGANTIC SNAKE FROM PATAGONIA

These two views, one from the side and one from the end, show the vertebrae and ribs as they are now mounted and exhibited at the American Museum. Two sections of the coiled body are shown, as they were preserved in the rock after other parts of the thirty-five-foot snake had weathered out and been lost.



which it was embedded proves to be hardened volcanic ash, showing that the creature was buried, and possibly was killed, by an ash fall during an explosive volcanic eruption. Probably most of the snake was preserved, but when found, much of it, including the head, had been eroded away by wind and weather and lost. The remaining parts consist of two segments of the body, one of forty and the other of five vertebrae, with the corresponding ribs. These have been mounted in the position in which they were buried, except that some of the ribs which were scattered and crushed have been restored to the natural position to give a clearer idea of the body form of the animal. From the arrangement of the bones it is clear that the long body lay in great folds as it was buried, and parts of two of these coils or loops are preserved.

Snakes are not common as fossils, and those found have usually been represented only by a few isolated bones, commonly single vertebrae. This specimen is one of the best ever found. It proves to belong to a new genus and species and has been given the scientific name *Madtsioia bai*. From a careful comparison of each of its vertebrae with those of many other known snakes, living and extinct, it was learned that its closest resemblance, and therefore in all probability its closest blood relationship, is with the constricting snakes, a family which includes the boa constrictor, anaconda, python, and many other forms less spectacular in size.

The length of our fossil species, judging from the parts preserved, must have been about thirty-five feet, and possibly more. It was thus at least as large as the largest certainly authentic records of recent snakes (regal pythons). As this is only a single chance sample of the species, with great probability that some individuals were considerably larger, it is fair to say that the fossil species probably averaged much larger than even the largest kinds of living snakes.

The large living relatives of *Madtsioia bai* are all tropical forms, and it is reasonable to conclude that this extinct snake lived in a similar climate. This gives another and very convincing glimpse of the great climatic changes of the earth, for Patagonia today is about as unlike a tropical jungle as can be imagined. It has a cold, dry climate, and its wind-swept pampas are completely devoid of trees.

The habits of this very ancient creature can be inferred with great probability from its characters and relationships. It was undoubtedly strictly carnivorous, and probably lived almost entirely on the warm-blooded animals of its time. Like its living relatives, it was not poisonous,

but killed its prey by crushing it in its great coils, then swallowed it whole. It must have been one of the most formidable and terrible foes of other animals of that epoch in South America. This was long before the appearance of man on the earth, and indeed so long ago and in such an isolated region that hardly any of the associated animals would look at all familiar in comparison with those now living.

This snake is another and a very important and interesting element in the chapter of earth history which is being read from the discoveries made by the Scarritt Expedition.

—G. G. SIMPSON

MINERALS

THE DRUMMOND COLLECTION.—Through the gift of Mrs. William Herbert, sister of the late Doctor I. Wyman Drummond, the American Museum of Natural History will shortly receive the collection of carved jade and amber that represents the result of a lifetime of arduous and discriminating selection on the part of Doctor Drummond in this field, as well as a very substantial intrinsic value.

The Drummond Collection, which will be displayed as a separate installation in the West Tower Room of the fourth floor, is especially rich in the older and rarer examples of carved jade, although magnificent pieces representing the K'ien-lung period are by no means lacking. Conspicuous among these latter, is a splendid thick disk of pure white jade consisting of twelve sections fitted around a central core; each of the twelve being carved in seal fashion with one of the signs of the zodiac. This unique object was presented to the Emperor K'ien-lung upon the event of his seventieth birthday by members of his court.

The carved Oriental (Burmese) amber contained in the Drummond Collection is, in all probability, the finest in the world. The pieces have been carefully selected for color as well as for perfection of carving, and include such objects as a ceremonial *joo-i* or "scepter of good luck" completely fashioned from a single piece of richly colored, transparent Burmese amber.

With the acquisition of the Drummond Collection, the American Museum becomes possessed of an outstanding exposition of Oriental lapidary work the importance of which can hardly be exaggerated.

MAMMALS

WHITE BUFFALO BORN AT NATIONAL BISON RANGE.—An albino buffalo was born this spring on the National Bison Range, maintained by the Bureau of Biological Survey, United States Department of Agriculture, near Moiese, Mont.

The white calf is one of about 75 young born so far this year in the herd of more than 400 animals.

Even when millions of buffalo lived on the great plains, a white buffalo was so rare that few were observed. "One or two in a lifetime was the utmost that any hunter secured," says Ernest Thompson Seton, and Dr. W. T. Hornaday tells that he met many old buffalo hunters, who had killed thousands and seen scores of thousands of buffalo, yet never had seen a white one. According to E. Douglas Branch there was only one white animal in the five million and more bison of the southern herd.

Doctor Hornaday believed that not over ten or eleven white buffalo, or white buffalo skins, were ever seen by white men. A single albino was raised about thirty years ago in a herd at Pierre, South Dakota, according to Dr. Robert S. Norton, Protector of the National Bison Range.



NORWAY RAT

The Norway rat has migrated from Europe to all parts of the civilized world

Trustees of the American Museum, and Dr. and Mrs. George C. Vaillant flew to Chicago the week-end of July 7, to see the unique collection of jewels from Monte Alban, Mexico, brought to the Century of Progress Fair by their discoverer Dr. Alfonso Caso. At the same time they observed especially the Maya Temple and the Social

Science Exhibits assembled by Prof. Fay Cooper-Cole. They were most impressed at the growth of interest in anthropology as expressed not only by the space given to these exhibitions, but also by the profound interest shown by the visiting public.

It is hoped that the projected plans for bringing the Monte Alban jewels to New York will materialize, so that members of the American Museum may see at their convenience these magnificent examples of the jeweler's art in ancient Mexico.

MEETINGS OF SOCIETIES

THE SIXTEENTH INTERNATIONAL GEOLOGICAL CONGRESS.—Delegates from all over the world met in Washington from July 22 to July 29 to attend the sixteenth session of the International Geological Congress. With the exception of Sunday, scientific papers and the discussion of them occupied each day of this period, the subjects under consideration being Appalachian orogenesis, measurement of geologic time, fossil man and contemporary faunas, geology of petroleum, batholiths and related intrusives, major divisions of the Paleozoic era, orogenesis, zonal relations of metalliferous deposits, geology of copper deposits and miscellaneous ore deposits.

Before the Congress began there were nine long excursions and twelve short ones from New York where headquarters were at the Geological Society House. During the sessions there were eight short excursions from Washington, and at the close there were four long excursions, two of them trans-continental, one to study the glacial geology of the central states, and the other to the iron and copper deposits of the Lake Superior region.

Despite uncertain conditions all over the world, the American committee was cheered early in the registration period by the numbers who had come, close to 900 being registered during the first two weeks. The delegates represented many countries, among them being E. B. Bailey of the

FOOTPRINTS.—Natural history is at our doorstep. Messrs. John T. Nichols and H. C. Raven, of the American Museum's scientific staff, have discovered the footprints of the Norway rat (*Rattus norvegicus*) on the lower (downtown) platform of the Eighty-first Street Station of the new Eighth Avenue Subway at about the center of the platform near the tiled wall. These footprints extend for about six feet, and will remain as a "signature" in the concrete platform as an enigma for some future scientist of 3000 A.D. to ponder.

SCIENCE OF MAN

DANISH ARCHAEOLOGICAL COLLECTION.—Mr. N. C. Nelson, curator of prehistoric archaeology at the American Museum, during the past few months has been engaged in classifying and cataloguing the large Danish archaeological collection which was purchased by the American Museum in 1925 from Dr. William Dreyer. It has taken Mr. Nelson more than a year to clean and repair this material which consists of relics of the stone, iron, and bronze ages, including about 100 pottery vessels—many of them containing the remains of human burials. The collection includes also a number of amber ornaments as well as ornaments of bronze. The pottery has been placed on exhibit in the Hall of Archaeology at the American Museum.

MONTE ALBAN JEWELS DISPLAYED.—Mr. Clarence L. Hay, secretary of the Board of

University of Glasgow; Fernand A. J. Blondel, chief engineer of the Department of Mines, France; Louis deLoczy, director of the Hungarian Geological Survey; Sir John Smith Flett, director of the Geological Survey of Great Britain; George W. Grabham, geologist of the Sudan Government and Vice President of the 15th International Congress; Amadeus W. Grabau, chief paleontologist of the Geological Survey of China; Arthur L. Hall, assistant director of the Geological Survey of South Africa; N. R. Junner, director of the Gold Coast Geological Survey; Victor Madsen, director of the Geological Survey of Denmark; Joseph Morozewicz, director of the Geological Survey of Poland; Carlos A. Marelli, director of the zoological gardens at LaPlata, Argentine; J. J. Sederholm, formerly director of the Geological Survey of Finland and member of the Finnish Parliament; Manuel Santillan, director of the Geological Survey of Mexico; Guiseppe Stefanini, director of the geological department of the University of Pisa; Hans Stille, formerly director of the Geological Survey of Saxony; Père Teilhard de Chardin, S. J., of Peiping, China; V. K. Ting, formerly director of the Geological Survey of China; Seitaro Tsuboi, member of the Research Council of Japan and of the House of Peers; Victor von Straelen, director of the Museum of Natural History of Belgium; Sir Arthur Smith Woodward, head of the department of geology at the British Museum. Other countries represented by delegates included Algeria, Australia, Austria, Czechoslovakia, Dutch East Indies, India, Morocco, Netherlands, Norway, Portugal, Roumania, Russia, Union of South Africa, Spain, Sweden, Switzerland.

The Committee on Organization of the Congress included Waldemar Lindgren as chairman; Edward B. Mathews, general treasurer; W. C. Mendenhall, general secretary; H. G. Ferguson and M. I. Goldman, assistant secretaries; L. K. Armstrong, H. Foster Bain, E. S. Bastin, A. M. Bateman, C. P. Berkey, Eliot Blackwelder, Isaiah Bowman, H. A. Buehler, B. S. Butler, R. A. Daly, A. L. Day, E. De Golyer, H. S. Gale, W. O. Hotchkiss, Arthur Keith, H. B. Kummel, H. Landes, A. C. Lawson, C. K. Leith, W. E. Pratt, F. L. Ransome, George Otis Smith, Scott Turner, W. E. Wrather, and David White. The Executive Committee consisted of the chairman, the general treasurer, the general secretary, H. Foster Bain, C. P. Berkey, E. DeGolyer, and David White.

The Geological Society of America deserves much credit for the success of the Congress of which it was the underwriter.

HONORS

ON June 7, 1933, Mr. James L. Clark, vice-director, in charge of preparation and exhibition, of the American Museum of Natural History, received an honorary degree of Doctor of Science from West Virginia Wesleyan College, at Buckhannon, West Virginia, in recognition of his work as naturalist, traveler, explorer, and sculptor of wild life.

DR. FRANK E. LUTZ, curator of insects in the American Museum, was recently elected vice-chairman of the Division of Biology and Agriculture of the National Research Council.

ACTIVITIES OF THE AMERICAN MUSEUM STAFF ABROAD

ON May 19 Henry Fairfield Osborn, Honorary President of the American Museum, staged a very pleasant surprise, in the form of a dinner to four members of the American Museum staff who were fellow-passengers with him on the steamer *Paris*, en route for Europe. The guest of honor was Prof. William King Gregory, who was the recipient of numerous gifts, including a leather manuscript carrier presented by Professor Osborn, a birthday cake provided by Mrs. Gregory, and a glittering model in ice of a new species of fish—an appropriate tribute to an ichthyologist from the *Maitre d'hotel*. The other guests were Prof. Milo Hellman, research associate in the department of anthropology, Dr. Robert T. Hatt, assistant curator of mammals, and Mrs. Hatt (Marcelle Roigneau) of the staff of the department of comparative anatomy.

PROFESSOR OSBORN, after a brief visit to the British Museum (Natural History) in London went to Paris to deliver his address on Aristogenesis before the Académie des Sciences (Institute de France). He exhibited three new charts of great interest, embodying the essence of his thirty-odd years of study of the fossil Proboscideans. One of these charts illustrates the gradual and regular addition of small new "conules" to the molar teeth in a certain phylum of Mastodonts, so that a tooth which in the earliest known ancestral stage only possessed seven (*Moeritherium andrewsi*) aristogenes (or rectigradations) finally finds itself in possession of thirty-seven (*Trilophodon macrognathus*) aristogenes in the latest known member of the series. His paper, delivered in French, was a carefully prepared exposition of his theory of aristogenesis and was very heartily received by his distinguished audience. It will be published in the fall of this year.

Professor Gregory, by invitation of University College, London, delivered a series of four lectures

before the departments of zoölogy and anatomy, on "Man's Place among the Anthropoids." Combating in considerable detail Prof. Wood Jones's view that man has been derived from distant relatives of *Tarsius* before the beginning of the lines leading to the anthropoid apes, Doctor Gregory marshalled the evidences from many directions that tend to support the traditional or orthodox scientific view that the anthropoids are man's nearest living relatives. At Oxford University, Doctor Gregory delivered an illustrated address on the "Evolution of the Jaws and Teeth of Primates." These lectures will be published by the Clarendon Press, Oxford, in October, 1933.

Prof. Milo Hellman went to the Royal College of Surgeons in London to study the skulls of Tasmanians there and to compare them with those in the Von Luschan collection of the American Museum. He and Doctor Gregory were the guests of Sir Arthur and Lady Keith at Down and visited the newly finished Buxton Brown Farm for Experimental Biology, of which Sir Arthur Keith is the director.

Doctor and Mrs. Hatt remained at the British Museum (Natural History) until August, then went to the Museum in Brussels. Doctor Hatt is studying various groups of mammals from the Belgian Congo, in preparation of a report on the American Museum Congo collections made by Messrs. Lang and Chapin. Mrs. Hatt is engaged in studying and recording the individual skull elements of mammals for a paper dealing with the number of the skull bones in different classes of vertebrates, which Doctor Gregory has in preparation, in coöperation with a number of his graduate students of Columbia University.

Mr. and Mrs. George Pinkley, who are also former students of Professor Gregory, are at University College, London, in the department of anatomy, where Mr. Pinkley is investigating

certain aspects of the evolution of the human brain, under the direction of Profs. G. Elliot Smith and D. M. S. Watson. As a result of Professor Gregory's visit, both these eminent scientists are very generously coöperating with the department of comparative anatomy of the American Museum, in furthering its plans for the investigation of the evolution of the human brain, under the terms of the bequest of the late James Arthur, a former life member of the Museum. Mr. Pinkley is also preparing materials to add to the American Museum exhibit of this subject, and Professor Watson has consented to deliver here the James Arthur lecture on the "Evolution of the Human Brain," in April, 1934.

ERRATUM

THE very interesting article by Dr. Robert Cushman Murphy in the July-August NATURAL HISTORY contains an inaccuracy concerning the distribution of the American holly. For sizable trees he places the northern limit on Fire Island, but there are many on Cape Cod, thirty or more feet in height, with trunks about a foot in diameter, particularly in the towns of Sandwich, Mashpee, and Barnstable.

He also ascribes the distorted trunks of trees in sand dunes to the effect of wind. As this also occurs in locations completely sheltered from severe winds, may it not be due to a sort of vegetable rickets from lack of many of the essential elements for growth in the sandy soil?

The sand is usually in comparatively large granules which probably makes it unavailable and is largely composed of quartz.

In support of this is the evident fact that most of these trees are stunted as well as distorted, trunks no more than two inches in diameter showing on cross section fifty to seventy-five annual rings of growth. LOMBARD CARTER JONES

Falmouth, Massachusetts

NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum:

Life Member

MR. A. K. MACOMBER.

Annual Members

Mesdames MARTIN AUSLANDER, ALICE HERRIOTT, MAURICE POLLAK, ROBERT RIESER.

Misses KATE R. ANDREWS, M. E. BARCLAY, ANNA C. BOWEN, MARGIE E. HOFFMAN, IRENE INGALLS, DOROTHY KING, LILLIAN C. SMITH, EMILY TOFF.

Doctor NELLIE P. HEWINS.

Messrs. MATTHEW C. BRUSH, REGINALD G. COOMBE, JOHN FOUNTAIN, J. E. FRASER, CHARLES A. GRAMET, CARL S. HALLAUER, DAVID E. HARROWER, CHARLES G. INMAN, DANIEL MANNING, MICHAEL PUORRO, J. STERLING ROCKEFELLER.

Associate Members

Mesdames JAMES W. ANGELL, MONTGOMERY ANGELL, HARLOW R. BROWN, JOHN LAIDLAW BUEL, MARSHALL, BULLITT, VIOLA F. BURNETT, E. R. DIMOND, A. W. HEWLETT, FRANK HOBART, JANET V. V. LYMAN, MARION I. SCHMIEDER.

Misses MARY COOPER BACK, MARY CHALLIS, ALICE B. FERRISS, ALICE M. HERD, GLORIA ISON, L. E. OLIPHANT, JULIA E. PATTISON, FRANCES SPALDING, ISADORE IRENE SMITH.

Doctors N. G. ATWOOD, FREDERICK H. KRECKER, A. REYNE QUIDO ZARUBA.

Professor Doctor RADIM KETTNER.

Professors EDGAR ALLEN, HAROLD S. KING.

Lieutenant CARRYL E. STAUFFER.

Messrs. ROBERT D. BONNEY, SAMUEL B. BOWEN, ALFRED WHITNEY BROWN, PERRY T. BROWN, RALPH W. BROWN, DANIEL B. BURNHAM, HAYWARD W. DILL, GEORGE S. ELPERN, P. W. FANG, CORBETT FRANKLIN, HAROLD T. GATES, C. HERBERT GROVER, DON HAYNE, WORTH HILLMAN, FRED D. HORTON, ERNEST INGERSOLL, GEORGE PERKINS MERCHANT, RICHARDSON KILBOURNE NOBACH, MURRAY ROSENSTEIN, WM W. SAUNDERS, EDWARD A. SCHUMANN, JR., J. CLINTON SHEPHERD, HARRY B. SMITH, H. D. SOLOMON, ROBERT E. TREYBAL, EDGAR WACHENHEIM, NEWTON V. WAGNER, JOHN A. WALLS, VERGER VAN WICKLE.



PUBLICATIONS—OLD AND NEW

Junior Astronomy News: 1933 Summer Fieldbook.

FIELDBOOKS and other aids to amateur naturalists have been "made by fools like me," but we fully realize, or should realize, that unfortunately a professional with an amateur viewpoint is almost an impossibility. On the other hand, both science and amateurs have suffered much from people who write well but wrongly. Since this astronomical fieldbook was written by high school boys and girls (with the exception of one article, "Celestial Objects Through the Telescope") it may be expected to have the amateur viewpoint; and since it has been carefully checked by competent authorities, we may trust that it is right as well.

The Junior Astronomy Club, sponsored by the American Museum, publishes a mimeographed magazine six times a year. The present Fieldbook is the summer issue of this *News*. It contains twenty pages of information on constellations, the moon, planets, meteors, variable stars, sun-spots, making a sundial, and so on. Although it scarcely meets the announcement on its cover, "Everything in observational astronomy," it is certainly worth ten cents to the purchaser and has been worth much more than that to the members of the club who produced it. A similar issue devoted to fall, winter, and spring skies is promised for publication in late October.

—FRANK E. LUTZ.

THE LIBRARY

THROUGH the patronage of several Museum friends the Library has come into possession of some unusually rare and valuable items.

The first, in point of time, is the *Sammlung auserlesener Vögel und Schmetterlinge mit ihren Namen . . .* by Jacob Hübner, octavo, published in Augsburg, 1793. This exceeds all other Hübner works in scarcity. Each of the one hundred colored plates contains one bird and one butterfly and it is for the latter (mostly microlepidoptera), rather than for the former, that the work is especially valued. Many of the species of butterflies represented had either never before been illustrated or only very poorly. As early as 1850 the work was considered rare. The Library is therefore most fortunate in becoming the possessor of this natural history treasure through the generosity of Messrs. Fred Church, Cyril F. dos Passos, and Bernard Heineman.

Another work which has gained in value not only through its own worth but also by its age and scarcity is the *Aboriginal Portfolio* by James

Otto Lewis, first edition folio, printed in Philadelphia, 1835, by Lehman and Duval. This collection of colored plates is the rarest of pictorial works relating to the American Indian and represents chiefs and squaws of many North American tribes as seen by Lewis at various Indian treaties. Mr. Ogden Mills, by his liberality in presenting an unusually fine copy of this long desired early American classic, has eminently enriched the Museum Library and the anthropological collections.

A modern tale of the romance of adventure is *West Made East with the Loss of a Day* by William K. Vanderbilt, quarto, privately published in New York, 1933. The author not only recounts interesting incidents and observations of his recent voyage through many waters, but adds much valuable natural history data, supplementing these by superb illustrations. Mr. Vanderbilt has graciously presented a copy of this magnificent volume to the Library.

NOVITATES

DURING June and July the following *Novitates* were published by the American Museum:

- No. 628. Birds Collected During the Whitney South Sea Expedition. XXIV. Notes on Polynesian Flycatchers and a Revision of the Genus *Chytorynchus* Elliot. By Ernst Mayr.
- No. 629. Braineasts of Two Typotheres and a Litoptern. Publications of the Scarritt Patagonian Expedition, No. 16. By George Gaylord Simpson.
- No. 630. The Bentonites and Closely Related Rocks of Patagonia. Publications of the Scarritt Patagonian Expedition, No. 17. By G. C. McCartney.
- No. 631. Four New Spiders of the Family Gnaphosidae. By Ralph V. Chamberlin.
- No. 632. A Skull and Mandible of *Giraffokeryx Punjabensis* Pilgrim. By Edwin H. Colbert.
- No. 633. Two New Rodents from the Lower Siwalik Beds of India. By Edwin H. Colbert.
- No. 634. A Simplified Serial Sectioning Technique for the Study of Fossils. By George Gaylord Simpson.
- No. 635. An Upper Tertiary Peccary from India. By Edwin H. Colbert.
- No. 636. New Genera and Species of North American Spiders. By W. J. Gertsch.
- No. 637. Diagnoses of New American Spiders. By W. J. Gertsch.
- No. 638. An Ancestral Crocodile. By Barnum Brown.
- No. 639. *Serbelodon Burnhami*, a New Shovel-Tusker from California. By Henry Fairfield Osborn.
- No. 640. A New Genus of Stegocephalia from the Triassic of Arizona. By Barnum Brown.
- No. 641. Experiments with "Stingless Bees" (*Trigona Cressoni Parastigma*) Concerning Their Ability to Distinguish Ultra-violet Patterns. By Frank E. Lutz.
- No. 642. Notes on Some Bombyliidae (Diptera) from Panama. By Reginald H. Painter.
- No. 643. Two New Diptera from Guatemala. By C. H. Curran.
- No. 644. Stratigraphic Nomenclature of the Early Tertiary of Central Patagonia. Publications of the Scarritt Patagonian Expedition, No. 18. By George Gaylord Simpson.
- No. 645. Living Bacteria in Ancient Rocks and Meteorites. By Michael A. Farrell.
- No. 646. Studies of Peruvian Birds. IX. The Formicarian Genus *Thamnophtilus*. Part I. By John T. Zimmer.

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The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor



A. KATHERINE BERGER
Associate Editor

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Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York, N. Y.

GEORGE L. ALPERS, Advertising Manager, Advertising Office, The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y.

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THE MATERNAL INSTINCT

Meshie, half-grown female chimpanzee, was delighted upon being allowed to hold Mary Raven, aged two and one half months. She was extremely gentle and solicitous of the baby's comfort, seeming to appreciate the trust bestowed upon her

(See "*Further Adventures of Meshie*," Page 607)

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PORTULACAS ARE ULTRAVIOLET

An "ultraviolet photograph" of what we call "red" (left), "yellow," and "pink" (right) flowers

another flower. Consequently, we have had thousands of papers and hundreds of thousands of lectures on the fascinating subject of the relation between floral colors and the insects that visit flowers. Unfortunately, however, these multitudinous dissertations treated of the floral colors we see

instead of considering the insects' view. In the same way we have discussed the colors as we see them on butterflies and moths, although the colors as butterflies and moths see them would probably be more to the point.

A red flower looks red to us because, out of all of the wave-lengths of light which we can see, it reflects only or chiefly the long ones which give us the optical stimulus we call red. If this flower reflected only these, an insect which cannot see red, at least as a color, would say, if it could talk, that such a flower is black or dark gray. If, on the other hand, such a flower reflected ultraviolet wave-lengths

which an insect can see, that insect, if it could talk and knew about physics, would say that the flower is ultraviolet color. Possibly it could even distinguish several colors in the part of the spectrum we call ultraviolet.

A red zinnia is an example of a "red" flower which does not reflect ultraviolet and a red portulaca is an example of one that does. A demonstration of this fact is relatively easy to make. Ultraviolet affects ordinary photographic plates but, since ordinary camera-lenses are opaque to ultraviolet, we must go back to the old pin-hole method of photography unless

we can afford lenses made out of quartz. I could not and, so, I used the pin-hole method. This method got results although the pictures are rather soft, not to say fuzzy. A blackened visiting card with a pin-hole in its center was put in place of the lens on my camera. In front of this was fastened a piece of special glass



ZINNIAS ARE NOT STRONGLY ULTRAVIOLET

An "ultraviolet photograph" of flowers that to our eyes match in color the portulacas



YELLOW BLACK-EYED SUSANS

Have the tips of the "petals" strongly ultraviolet but the bases not so

which transmitted most of the ultraviolet in sunlight but, except for a very little red, not the wave-lengths greater than about 4000 which we can see. I got rid of the effects of the red by using a photographic plate that is not sensitive to it. In other words, photographs taken with this contraption are photographs of the ultraviolet color or colors. Now let us examine some of these photographs.

Portulacas of many colors bloom in my garden; also zinnias in a wide range of color. I picked what seemed to me to be a red, a yellow, and a pink portulaca, and found from the photograph that all are strongly ultraviolet except for an interesting pattern of no ultraviolet in the center of each. On the other hand, neither a red, a yellow, nor a pink zinnia has any ultraviolet and, so, the photograph of them is just a mass of black. If floral colors are of any interest to insects—and they may not be—these zinnias



AN INSECT'S VIEW OF *PREPONA*
Compare this "ultraviolet photograph" with the cover painting and with *Agrias*



AGRIAS TO IT

A photograph made through a screen that cut out the colors we see but passed the ultraviolet

do not have much to say for themselves.

A yellow pumpkin flower is rich in ultraviolet and the yellow black-eyed Susans have a striking ultraviolet pattern on the tip of each "petal." A yellow evening primrose is strongly ultraviolet, but neither a white morning glory, nor a lavender cosmos is.

While not all yellow flowers (for example, the yellow zinnia; also prickly poppy, butter-and-eggs, at least some golden rods, and so on) are ultraviolet, most of them seem to be. In this connection a yellow spider much given to hiding in yellow flowers is interesting. According to theory, the yellow color of the spider prevents flower-visiting insects from seeing it against the background of a yellow flower in time to avoid being caught. However, the spider is only slightly ultraviolet and, so, to an insect that can see ultraviolet the yellow spider must be rather conspicuous as it sits on a yellow-ultraviolet flower.



AGRIAS TO US

The butterfly photographed through a screen that cut out the ultraviolet but passed the red



THE WIDOW

This common moth has a rather complicated pattern of black and what we call white

curved band of red across the middle of each front wing from base to nearly the outer margin. In front of this the wings are largely dull black and back of it there is a broad patch of beautiful iridescent blue, changing to black as the light strikes from certain angles. The hind wings have a row of red spots just inside

Turning to butterflies and moths, we find a similar problem. In each of the accompanying photographs taken through a screen which cuts out the colors we see, you will notice a line of three small squares. These are photographs of the ultraviolet reflection from squares of different kinds of paint, all appearing to us to be "pure" white; but the one on the left strongly reflected ultraviolet, the middle one a bit, and the one on the right not at all. We used these squares as a scale in judging the relative amount of ultraviolet in the insect which was photographed at the same time on the same plate. It is a bit difficult to present the results without the specimens or at least colored pictures of them, but the fact that many butterflies and moths have ultraviolet patterns, while others do not, just as some have red or blue patterns and others do not, is the important thing.

These ultraviolet patterns may or may not correspond to the humanly visible ones. For example, the butterfly *Prepona buckleyana* has a broad

of the black margin and the central part of each hind wing is that iridescent blue-black. The painting by Arthur A. Jansson on the cover of this magazine shows what this insect looks like to us. Compare it with the accompanying ultraviolet photograph on page 567. The red spots on the hind wing are not at all ultraviolet but about half of the red on the front wing is ultraviolet; the remainder not. Most of the blue is also ultraviolet. A closely related species, *Agrias sardanapalus*, has a very similar ultraviolet pattern although the pattern we see is quite different: no red on the hind wing but red over the entire basal two-thirds of each front wing.

The ultraviolet pattern of the black and white moth *Catocala relict*a is the same



CABBAGE BUTTERFLIES

To us these adornments of the roadside and enemies of gardens are conspicuously white with black markings

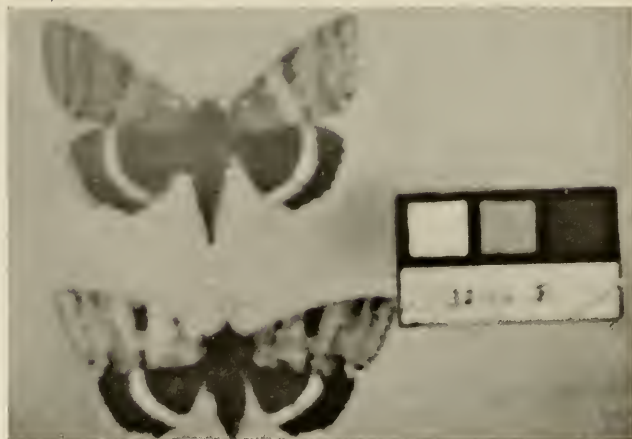
THE WIDOW IN ULTRAVIOLET

Also the widower. On each the areas that we call white are also strongly ultraviolet

as its white pattern; but the black and white *Pieris rapae*, the common cabbage butterfly, is not at all ultraviolet.

The male of our large, long-tailed moth, *Actias luna*, is not ultraviolet except for the tiny centers of its eye-spots, but its female is rather uniformly ultraviolet except for the dark marginal band of the front wings and the rims of the eye-spots. Neither the yellow form nor the dark form of the female tiger swallow-tail is ultraviolet—both blonde and brunette are brunettes to the male who apparently sees ultraviolet well and yellow but poorly.

Much has been made of "mimicry" in butterflies. According to this theory a species which is good food for birds or lizards gains an advantage by looking like a species that is distasteful to these vertebrates. There is no work to indicate that either birds or lizards can see ultraviolet, and yet the ultraviolet patterns of those "mimics" that we studied are as good—or better—matches, one for another, as the patterns we see. Apparently there is either more to be known about the



visual powers of vertebrates or there is at least an addendum to be made to the mimicry theory.

And so on.

Nature seems to be full of a color or colors all unseen by man. How do we know that insects can see this ultraviolet and do not see red, for example, as a color?

Many years ago Lubbock did an interesting thing with ants. When a colony of ants is disturbed, the workers quickly carry the larvæ and pupæ into the darkest place they can find. Lubbock arranged a narrow trough so illuminated with sunlight passed through a quartz prism that, in the spectrum of light which was formed, red was at one end of the trough and ultraviolet was at the other. Of course,

the red end seemed to man illuminated with that color. The ultraviolet end had no wave-lengths of light that man can see and therefore appeared to him to be very dark. Not so to ants. When Lubbock scattered larvæ and pupæ throughout the trough the ants hurriedly carried these precious objects out of



WHITE NOT ALWAYS
ULTRAVIOLET

An "ultraviolet photograph" of white cabbage butterflies. See opposite page



THE FEMALE LUNA

To us she is largely a most delicate green with four conspicuous eye-spots and a dark front margin

of the fact that when these insects have found a source of sweets such as sugared water they return repeatedly for more. If a small dish of sweetened water be put on a blue plaque set among other plaques of a great variety of colors and of shades of gray, each with a dish but not sweets, the bees will quickly

the ultraviolet end of the spectrum and piled them in the red end.

When we were working on ultraviolet floral color we made a long narrow box with a window at each end. A flower-visiting insect put into this box tried to get out through the window that looked brightest to it. If we put at one end a piece of glass which transmitted the ultraviolet of sunlight but let through little or none of the light we see, and put at the other end a glass of any color except ultraviolet, the insects would fly to the ultraviolet window in an attempt to get out.

But this experiment was somewhat artificial. While it showed very clearly that insects react toward ultraviolet as though they see it, there was no proof that in nature they either could or would pay attention to such things as the ultraviolet patterns of flowers and butterflies.

For some time investigators, particularly in Munich, have been testing the visual powers of the ordinary honey-bee with a very satisfactory method. It takes advantage

associate blue with sweet. In other words, they can be "trained" to hunt out a blue plaque among plaques of other colors. In a "test" the plaques are moved into new positions and an empty dish is placed on each, including the blue. The bees, hunting for sweets that are not there, crowd on and around the blue plaque but not at the others. They are able to distinguish blue from other colors and from shades of gray. If the training consists in associating red with food the bees fall down in the test because, while they go to red looking for food that is not there, they go also to dark gray plaques. They are color-blind to red.

It seemed desirable to try this experimental method with ultraviolet using some other species than the more or less



THE MALE LUNA

To us he is much like his female except that the green is strongly tinged with yellow

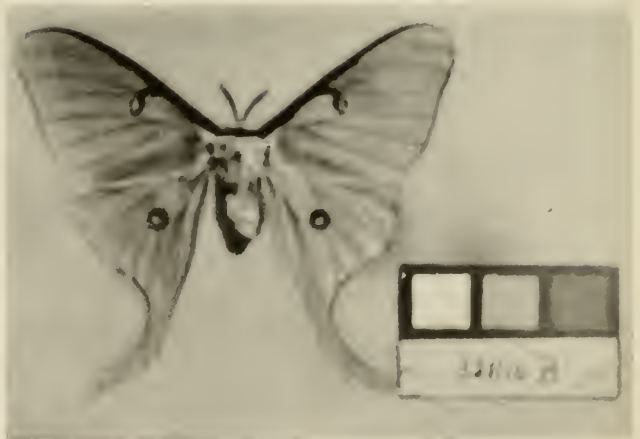
THE FEMALE LUNA

Her green is so strongly tinged with ultraviolet that this ultraviolet photograph appears normal

domesticated honeybee. Accordingly, when an opportunity came to spend a few weeks in Panama at the Barro Colorado Research Laboratory, I prepared what seemed to be necessary paraphernalia for a test on the stingless bees (*Trigona*) that occur there. A technical report of this work has just been published in the American Museum *Novitates* and may be sketchily summarized as follows:

Had we been easily discouraged, we would have stopped in a few days because these bees paid no attention to our most tempting offers of sugar, honey, maple syrup, and other sweets, including even some grenadine that a former worker in the laboratory had left. But those who are easily discouraged do not experiment with insects.

A colony of these bees had its nest in a hollow wall of the laboratory building. They got in and out of the hollow through a small hole in the side of the building. Now, bees and their relatives have a very acute "sense of location." These bees, when returning to the nest, had no trouble



at all in finding the entrance-hole. In the Munich experiments the colored plaques were moved around every hour or so to prevent the bees from finding the food by its location. We could not move the hole in the laboratory wall from place to place. In spite of that, we decided to try setting up in the minds of the bees a definite and provable association between the entrance to their nest and color patterns involving ultraviolet.

The tests of our success involved another difficulty. The Munich experimenters marked with paint the bees that came to their school so that the examiner could distinguish between bees that had been trained and those that had not. In our work we had up for examination a whole colony including young bees that had emerged after the experiment started and that, consequently, had received little or no training. This difficulty could not be avoided and was, accordingly, accepted. It was our task to train enough bees of that colony so thoroughly in the belief that a certain color-pattern marked the entrance to their nest that, when



THE MALE LUNA

Unlike his mate, he shows no ultraviolet except in the centers of his eye-spots. She is blond, he brunette



THE YELLOW FEMALE TIGER
In the North most of the females of this swallow-tail are colored yellow much like the males

were changed frequently.

After less than a week's training the bees were tested three times in rather rapid succession with fresh cards by placing the "nest pattern" to one side of the nest entrance and two cards with the other pattern equally near the nest entrance and then counting the number of

we moved this color pattern away from the entrance, a greater number of bees than could be accounted for on the basis of chance would pick out this pattern on returning to their nest.

After a few preliminary trials which seemed hopeful, we asked the bees to distinguish between the two patterns *c* and *d*, which to our eyes were the same: circles with alternating segments of black and white. However, the white of one pattern reflected ultraviolet and the white of the other had little or no ultraviolet. This is shown by the accompanying photograph of these patterns taken through a pinhole and a glass which transmitted ultraviolet but not the light we see.

We chose the pattern of black segments alternating with ultraviolet white to mark during the training period the location of the nest. A card with this pattern was so placed that the entrance to the nest was through a hole in the center of the card. Two cards like this except that the white was not strongly tinged with ultraviolet were placed near the first and their positions

bees which went to each card. If pure chance governed their choice, only one-third of the bees would choose the single card on which the white segments were tinged with ultraviolet. the pattern that during the preceding few days had marked the entrance to their nest. As a matter of fact, however, out of sixty-three bees fifty-six went to that pattern looking for the entrance to their nest which was not there.

I do not shake dice; but if I did shake dice and my opponent got either a five or a six eight times out of nine I would think that his dice were loaded. In somewhat the same way it seemed that the minds of these bees were loaded with the idea that black segments alternating with ultraviolet white marked the location of their



THE DARK FEMALE TIGER
Particularly in the South females of this swallow-tail may be dark with yellow only in marginal spots

THE YELLOW FEMALE TIGER
Has so little ultraviolet that she
must appear to her mate about as
dingy as her brunette sister

nest and that a similar pattern in which the white was not strongly tinged with ultraviolet was of no interest to a home-coming bee.

The experiment certainly proved once again that insects have something sufficiently like a mind to be trained in the formation of simple associations. It almost proved for the first time that a truly feral species not only distinguished but made use of ultraviolet color or colors in its normal environment. Furthermore, this use was connected with such an important and highly developed activity as finding the way home. It did not certainly prove this because there was the possibility that the two white paints differed in odor which the bees could perceive but which we could not any more than we could perceive the difference in color. This possibility was eliminated very easily by the next experiment.

What we called pattern *e* was a white circular area in which the lower half was strongly tinged with ultraviolet and the upper half was not. Pattern *f* was also a white circular area but in it there were



eight segments, half of one kind of white and half of the other, the two sorts alternating. Since there were equal areas of each kind of white in each pattern, each pattern had the same odor, if any. The accompanying photographs show how different they probably are to a creature that can see ultraviolet.

During training pattern *f* was used to mark the location of the nest and *e* was its foil. Adding together the results of seventeen tests, some of them complicated by the use of still other patterns, out of 630 records of homecoming bees 506 were at *f* and only 124 at *e*. This was a ratio of 4.1 to 1 in favor of *f*, the "right" pattern, although the ratio on the basis of chance would have been only 0.8 to 1. Clearly the bees recognized and used in returning to their nest the differences in distribution of ultraviolet and of not-ultraviolet in these two patterns.

Other experiments further emphasized the point and, altogether, they showed that discussions concerning the origin and function of color in nature must certainly include the humanly invisible



THE DARK FEMALE TIGER
Has no more ultraviolet than her
yellow sister but, on the other
hand, she has as much



MIMICRY AS HUMANS SEE IT

The upper pair are male and female *Planema aganice*. The light areas on the male are pale yellow; on the female, glistening white. Theoretically, that species is distasteful to insect-eating birds, and the other two, *Pseudoacra tarquinia* and *imitator*, though edible, are avoided because they look like *Planema*.

ultraviolet if the vast majority of animals having eyes come within the limits of the discussion. Even if the world has been made for man he is not the only creature on it.

POSTSCRIPT.—The results of some experiments made after this article was completed are almost startling. They were done in coöperation with Mr. E. N. Grisewood of New York University's department of physics, and will be more fully described in the American Mu-

seum's technical publications. As untechnically as possible they are as follows:

The ultraviolet which we have been discussing is the ultraviolet of sunshine, the wave-lengths down to about 3000 but chiefly longer than about 3500 Ångstrom units. It is possible to produce artificially radiation of much shorter wavelengths; but when they are shorter than about 2500 Ångstroms and yet not short enough to be X-rays they can be transmitted only in a vacuum, ordinary air being



MIMICRY IN ULTRAVIOLET

These are the same *Planema* and *Pseudoacrea* photographed through a screen that cuts out the colors which birds can see, but passes the ultra-violet which apparently is visible only to insects and possibly to their near relatives. It would seem that "mimicry" has gone beyond its theory

practically opaque to them. By means of a very special arc and a quartz spectrograph, Mr. Grisewood produced and isolated a radiation band of 2537 Ångstroms wave-length. It is rather safe to say that no insect in nature ever had an opportunity to see such a light, but, in advance of trying, it would not be safe to say that an insect, given the opportunity, could not see it. So, we tried.

We placed a short glass tube lengthwise in the path of the beam. The tube

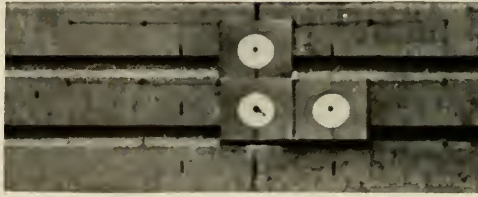
was provided with a quartz window at each end and insects of the genus *Drosophila*, the small flies common at our fruit-baskets, were placed in the tube. These insects are inclined to go toward what they see as light. A record was kept of the position of each fly every second (literally) of the time it was under observation in the tube.

The record left no room for doubt: the flies can see this ultra of ultraviolet, a wave-length (color?) that almost certainly

neither they nor their ancestors ever experienced in nature because atmosphere enough to support insects thoroughly obscures this wave-length in light from the sun. What is more, when a flood of "ordinary" light with an intensity of 120 foot-candles was poured into the other end of the tube as a counter-attraction, the flies were still inclined to go to the narrow beam of 2537 Ångströms as being even brighter to them.

What is the meaning of this capability

of insects' eyes? I do not know. There is, of course, a possibility, although apparently not a probability, that it is not vision in the usual sense of the word. It appears to be another example of a complicated, definite thing—in this case a physiological phenomenon; in others an instinct, or a structure, or a color—that has arisen without being of any benefit to its possessor. At least, these experiments show once again that we still have much to learn about insects.



ABOVE IS AN ORDINARY PHOTOGRAPH OF THE LABORATORY WALL WITH THREE OF THE PLAQUES IN POSITION. THE CENTRAL ONE IS THE *f* PATTERN AT THE NEST OPENING. A BEE IS ENTERING FROM THE RIGHT. THE OTHER TWO PLAQUES BEAR THE *e* PATTERN
BELOW ARE FOUR PATTERNS AS THEY APPEARED TO US AND UNDERNEATH EACH AN ULTRAVIOLET PHOTOGRAPH OF IT. BEES CLEARLY DISTINGUISHED BETWEEN *c* AND *d*; ALSO BETWEEN *e* AND *f*



"Somewhere in Africa" — When the Shadows Lengthen

LETTERS FROM AFRICA

BY F. TRUBEE DAVISON

President, American Museum of Natural History, and Leader of the Davison African Expedition

The following letters written from Africa by Mr. Davison to his sons deal with the trip undertaken by himself and Mrs. Davison in quest of elephants to complete the habitat group of such beasts in the Akeley African Hall of the American Museum. The Davisons left New York on June 15, reached Egypt by steamer, and made the 2500-mile journey from Cairo to Nairobi by air. They were accompanied by Lieut. Elwood R. Quesada, Army Air Corps pilot. In Nairobi the Davison party were the guests of the Martin Johnsons. Alfred Klein, who is referred to occasionally, is a taxidermist and big-game hunter who has done a great deal of museum work. Mr. and Mrs. Davison returned to New York in October.—THE EDITORS.

THIS letter is being written from the back of Klein's truck while our trackers are investigating some elephant tracks. The boys have been gone more than three hours and should be coming back pretty soon. Perhaps the elephants have gone so far and fast that we cannot overtake them; or maybe the wind is wrong and we cannot follow them because they would scent us and run away.

So far Mother and I have each shot a bull elephant for the Museum. Mine was very small and Mother's is medium-sized. We want to get two cows for the rest of the group but they must be ones that do not have calves.

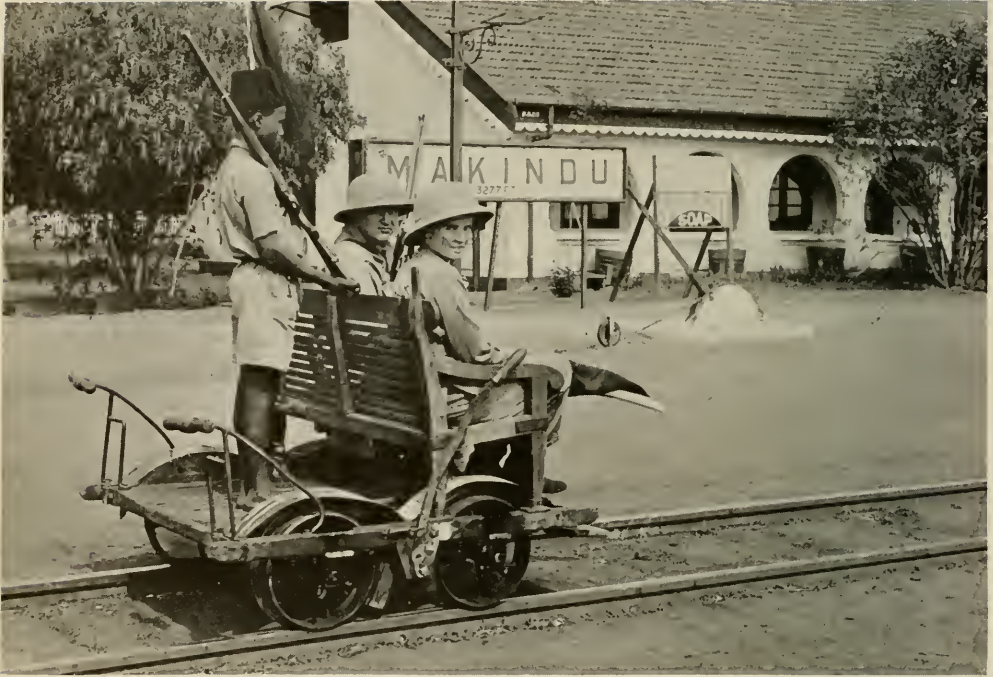
Can you picture Mother shooting an elephant? I will tell you about it.

We were out scouting in two cars and

had not seen a single elephant all day. Late in the afternoon we decided to go back to camp. Seven miles from home one of the natives—squatting in the back of the truck—whispered "Tembo, tembo." At that instant we saw five elephants about one hundred yards in the bush and at the same time hit an awful bump in the road. That made a terrible racket and the elephants started to run away.

We stopped the cars and followed Mafuta—our head tracker—into the bush. There was a big bunch of us, probably twelve or so, and we went as quietly as we could, being sure that we kept the wind blowing from where we thought the elephants were, toward us.

After going about a quarter of a mile, Mafuta pointed to some small trees about



ONE MEANS OF TRANSPORTATION

President and Mrs. Davison in Africa board a jungle club car for a trip

seventy yards away. I could see a dim shape, very, very big, moving among them, and two white streaks, which were tusks.

They could have seen us easily if they had decent eyes, because we were in plain sight, but the wind was right so they couldn't hear or scent us. Al Klein and Mafuta looked them over carefully. We wanted one not too big and not too small. Finally Al pointed to one practically hidden by the trees and said he looked suitable.

Now, elephants may look big to you in the Zoo, but it is nothing compared to what they look like in a bunch and with nothing between you and them but a few yards. Their size and power are overwhelming, and you have to hit them in the right place or you are likely to find yourself in serious trouble. Several natives have been killed around here in the past two weeks.

After two or three minutes the one Al

selected for Mother to shoot stepped out in the open and stood sideways to us. The others were in back. Your Mother raised her gun. Her knees may have been knocking together but she certainly didn't show it. A couple of seconds later there was a roar,—the gun. The elephant let out one grunt, caved in, dead, and in one shot. It was an extraordinary sight to see that great beast go down in a heap. They are magnificent animals, and I, for one, could never shoot one just for sport.

Klein and Martin Johnson fired a few more shots into him just to make sure he was through, but that was when he was down and dead. He didn't even roll over, but simply collapsed.

So now we have the two cows to get and then we will leave the Tana River and go back to Nairobi, which is 250 miles from Garissa, which is near us here. I came down with the nine trucks, but Mother flew down.

Then we will go to Tanganyika by air

and join our trucks again. When we do that, will depend on our success here. We are having a marvelous time and are collecting a lot of things for the Museum.

.....

We have not yet seen any lions but we have heard them. They are very plentiful in Tanganyika, however. Our mechanic had one walk into his tent down there. The lion was just thirsty and not hungry! Thank goodness!

Our elephant hunt is now over and we have completed the group for the Museum and then some. We wanted four medium-sized elephants for the Museum and up to day before yesterday, we had three. I got the first one,—a young bull; Mother got the next, a larger bull, and Pete Quesada got a medium-sized cow. So the fourth was to be another cow, and we wanted to be careful not to get one with a calf.

On August third we set out with our black trackers before daybreak. Before

long we found some fresh tracks of a group of elephants and waited in the car to let the trackers follow the trail. In about an hour one of them returned, excited and out of breath. They had located a herd. We grabbed our guns and cameras and started into the brush.

After about an hour, we came on Mafuta, Klein's gun bearer, and the most marvelous tracker you can imagine. The bush was very thick and he pointed about fifty yards ahead; we could see the huge hulk of an elephant's back tower above the bush. At the same time there was a lot of crashing as the animals moved about, feeding. We manœvered first to one side and then the other in order to see better, but the bush was too thick, and, at times, from the crashing among the trees, it sounded as though the elephants were coming out right on top of us, but they didn't.

Soon they moved off. Mafuta and



A LESSER KUDU FOR THE AMERICAN MUSEUM

Lieut. Elwood R. Quesada, pilot, bags something almost as swift as an airplane



FOR THE AKELEY AFRICAN HALL

President Davison surveying the first elephant to be shot by him on his expedition for the American Museum

another tracker named Isaiah followed them and, when the elephants stopped, came back and led us up to them again. This time we got a good look. Twelve or fifteen stood in a bunch with their tails toward us and about thirty yards away.

They were so close together it was impossible to pick out a cow and one without a calf. For five hours we followed and studied them, often very, very close, but never sure enough of any particular one to shoot. Believe me, it was a thrilling five hours! They look as big as the Grand Central Station,—but there was one very cunning little calf about two feet high, playing around the old folks.

At last a calf-less cow presented a fine target and I fired. Then started the most exciting and dangerous two minutes I have ever been through. My bullet hit the cow in the neck and broke the spinal cord. She went down, instantly killed. It sounded like a ton of bricks falling.

Immediately the herd stampeded and milled around in every direction, as they didn't seem to know where the danger was. But within two or three seconds a big bull picked us out and came for us like an express train.

Can you imagine how we felt? As a matter of fact, we didn't have time to think. Mother had her movie camera going all the time and was standing in back of me. Well, the elephant came and came and came, followed by the herd. Klein yelled at him, hoping to turn him, but still he came. I had one shell left in my double-barreled gun, and shot at his head. Klein and Pete shot at the same time. I was off my balance and we were in fairly thick bush, and my foot caught as I stepped back from the kick of the gun, and down I fell on my back in the thorn bushes. Now, two things happened as I fell: first, I saw the bull go down, and, secondly, I knocked your mother down,

too. We were lying flat on our backs in the thorns. Klein yelled to run. Pete shot again. Isaiah and a Somali guide had disappeared over the horizon.

After what seemed an hour, we got out of the thorns and followed the rest back. As we went, my gun empty, my gun bearer, Hassan, kept yelling "Shoot, shoot," but I didn't know what at. After going straight back for about twenty yards, I reloaded and saw the rest of the herd going off a little to our right. After the bull, their leader, had gone down, they apparently changed their course and bore to their right, so we continued our retreat to the left and they dis-

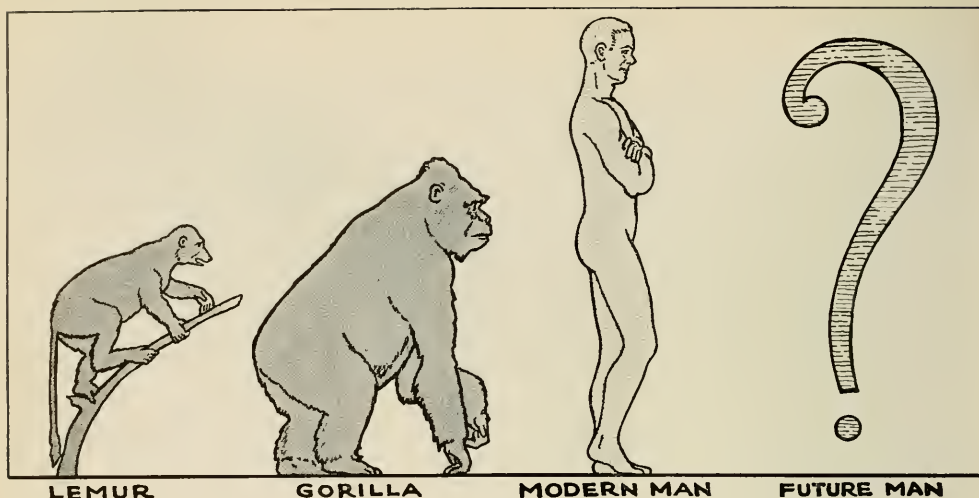
appeared. We weren't a bit sorry to see them go out of sight.

The turmoil was over, and we stopped to reorganize and take stock of the situation. Pete and Klein went over toward the bull. But he was not dead, and tried to get up! Klein put two bullets into the bull's brain as he lay just eighteen paces from where we had stood as we brought him down; and that was the end of that.

So now we have five elephants instead of the four we wanted, but we are going to try to bring them all back to the Museum, as I am sure that bull will be a good addition to the group.



MAJESTIC MOUNTAINS PROVIDE A BACKDROP FOR A WATER HOLE IN THE ELEPHANT COUNTRY OF KENYA COLONY



MAN—500,000 YEARS FROM NOW

Trends and Influences Now at Work in Changing or Modifying the Physical Characteristics of Civilized Man—A Scientific Attempt to Forecast What May Occur in the Future Evolution of Man

BY H. L. SHAPIRO

Associate Curator of Physical Anthropology, American Museum

IT sometimes occurs to the anthropologist, perhaps more often than to others, to wonder what manner of men will replace the mankind he so assiduously studies. His contemplation of the evolutionary series terminating with modern man naturally suggests the probability of its continuation into the future when the contemporary human type will have receded to the position of an ancestor to a still more advanced variety of man. And his concern with the efforts of the human organism to adjust itself to its environment foresees a future when these adjustments will have been made and new conflicts will have replaced the old. But although the anthropologist may permit the play of such speculations in his reverie, he rarely ventures to fix them in irrevocable print. Perhaps this lack of temerity comes from a natural reluctance born of the only too apparent imperfections of his understanding of the living man within his

calipers and the fossil fragments on his shovel.

But potent as the inadequacy of our knowledge is in discouraging among men of science a free prophetic expression on the future state of mankind, I am inclined to believe that there are other equally effective reasons for their reticence. Among these is the inertia of orthodoxy. Absorbed in man's present and in his past, anthropologists have become entrenched in the belief that their science is concerned only with these phases of human evolution. Although I share with them their feeling of groping in the dimmest of lights, I cannot but believe that a few rays of this feeble illumination do reveal a little of the way before as well as the path behind us. Nor do I concede that the future is an improper sphere for science. After all, are we to conclude that what we know of man's past has no meaning for his future? The astronomer does not hesi-

tate to predict in tones of conviction the heavenly events to come, and the meteorologist has made it his business to forecast the state of the weather, occasionally incorrectly, alas. But how often rightly! The anthropologist may aptly reply that these specialists have a better basis for prediction. I admit it, but I still insist that the future need not and should not be a completely alien field. Perhaps we may meet on the compromise that when we know more about the complex variables that sustain and modify the human organism, we may then attempt a few tentative prophecies. But that seems too distant a day. Let me, instead, lift the shroud a little. It is too long to wait for the formal unveiling.

THE DANGERS OF PROPHECY

But before you step forward to peek into the future, I shall say a few words about the nature of prophecy in general. The rôle of the prophet is a dangerous one. But if you must thumb the Sibylline leaves there are two courses, at least, by which you may evade the judgment of your disillusioned victims. You may follow the wise example of Delphi and a host of lesser and more recent practitioners by couching your predictions in terms so general and so terrifying that any of our ever besetting woes may easily fit them. But it is not a part of acumen, if you hope to profit by prophecy, to rely on the limbo of the human memory to engulf your errors. Inevitably you will meet your Nemesis in some unpleasantly retentive old gentleman who will confront you with your unfortunate mistakes. The other procedure to be recommended is the projection of your field of operation so far into the future that you and your guesses will have been long forgotten when the day of fulfillment comes around. I have chosen this latter method. But the distance I have selected is not a measure of my survival

into posterity, nor is it the result of timidity. It is simply the limitations of my subject.

A FUNDAMENTAL PREMISE

In all fairness to my readers I must admit that all my prophecies are prefaced by an "if." I do not very well see how this can be avoided. It would, of course, be much more satisfactory were I able to say thus and so (and no other) is to be. You could then exclaim "Isn't science wonderful," while I could be occupied dodging the brickbats of other specialists in fields having a bearing on human affairs. For, since man is intimately associated with nature and is definitely fixed in a social setting, it is apparent that a number of sciences converge upon man. Significant alterations in man's natural or social environments might conceivably change the course of human evolution. It follows, therefore, that any sound anatomical prediction must be made with future man's natural and social environment in mind. If some astronomer reveals that the earth is due to undergo vast readjustments in the course of the next few millenia, requiring fundamental modifications in man's manner of living, naturally my prophecies will then be worthless. Similarly, if a distinguished philosopher assures us (and if he is right) that the toxic accumulations of civilization will have completely destroyed all culture in 10,000 years, then, too, my predictions go for naught. For these reasons I must premise my remarks by a brief picture of the world, as I conceive it, in which our man of the future will live.

In this world-to-be I do not see any radical change in man's physical environment. The earth, we have no reason to doubt, will continue in its orbit at a speed not perceptibly different. Nature, perhaps rather more under control than now, will function in the accustomed way



THE REFINEMENT OF THE SKULL

This photograph illustrates the sex differences in the skull and the evolutionary changes which have occurred from anthropoid to modern man. The front skull in each of the pairs is a female. The series begins on the left with the gorilla, followed by Australian aborigines and concluding on the right with present-day Europeans. It is interesting to observe that while the human skull has gradually become smoother and more delicate in contour, the female has always been somewhat in advance of the male

with occasional eruptions to warn man of his human and finite powers. Inevitably in the course of this long period of time civilizations will have declined and new ones will have arisen to take the lead for a time. Perhaps on several occasions civilization will come perilously near to barbarity, but it will ever spring anew and to dizzier heights. There is nothing in human history inconsistent with this view. Nor, on the other hand, do I share the opinion of some that man will have become so enmeshed in machines that he will have lost the function of his appendages through disuse. No, the use of our arms and legs, even though it be only for sport, will be vigorous. In this I agree with Aldous Huxley in whose brave new world man employs machines to his enhanced satisfaction but nevertheless enjoys the exercises of his body.

It is conceivable, even inevitable, in the future society of which our man will

be a part that the population will be mated as carefully as the animal breeder now controls his stock. To some extent this may interfere with the direction of human development, but it will not deflect the stream of evolution very far from its course. Finally, it must be understood that my predictions concern Europeans especially, although some of my prophecies may be applied with equal assurance to other stocks.

Let us begin this hasty pre-view by focusing our eyes on a distance of say 500,000 years. We might, of course, have taken 1,000,000 or even more years, but I prefer to be modest. On the other hand, some of my readers, no doubt, are slightly myopic and will have little interest in a world as remote as this. They will find it difficult to feel grand-paternal toward their great^{16,666} grandchildren. But let them remember that even their own children may resemble themselves

as little as their future descendants. And yet who would deny their interest in their offspring. But my real reason for not limiting our vision to 1,000 or 10,000 or even 50,000 years hence is that it would be rather difficult in the hasty glimpse, which we are about to take, to find much in the way of interesting differences. For man does not change very rapidly, and we must allow him sufficient time to undergo a few modifications.

As a matter of fact when we look back over man's dilatory path we are somewhat amazed that although, measured in time, long eras have passed since the upper Paleolithic Age, yet in the way of

modern improvements the gain seems negligible indeed. We must perforce delve even deeper into the human past—to the period of Neanderthal Man and even earlier to the days of *Pithecanthropus*—before sharp differences from *Homo sapiens* appear to the unprofessional eye.

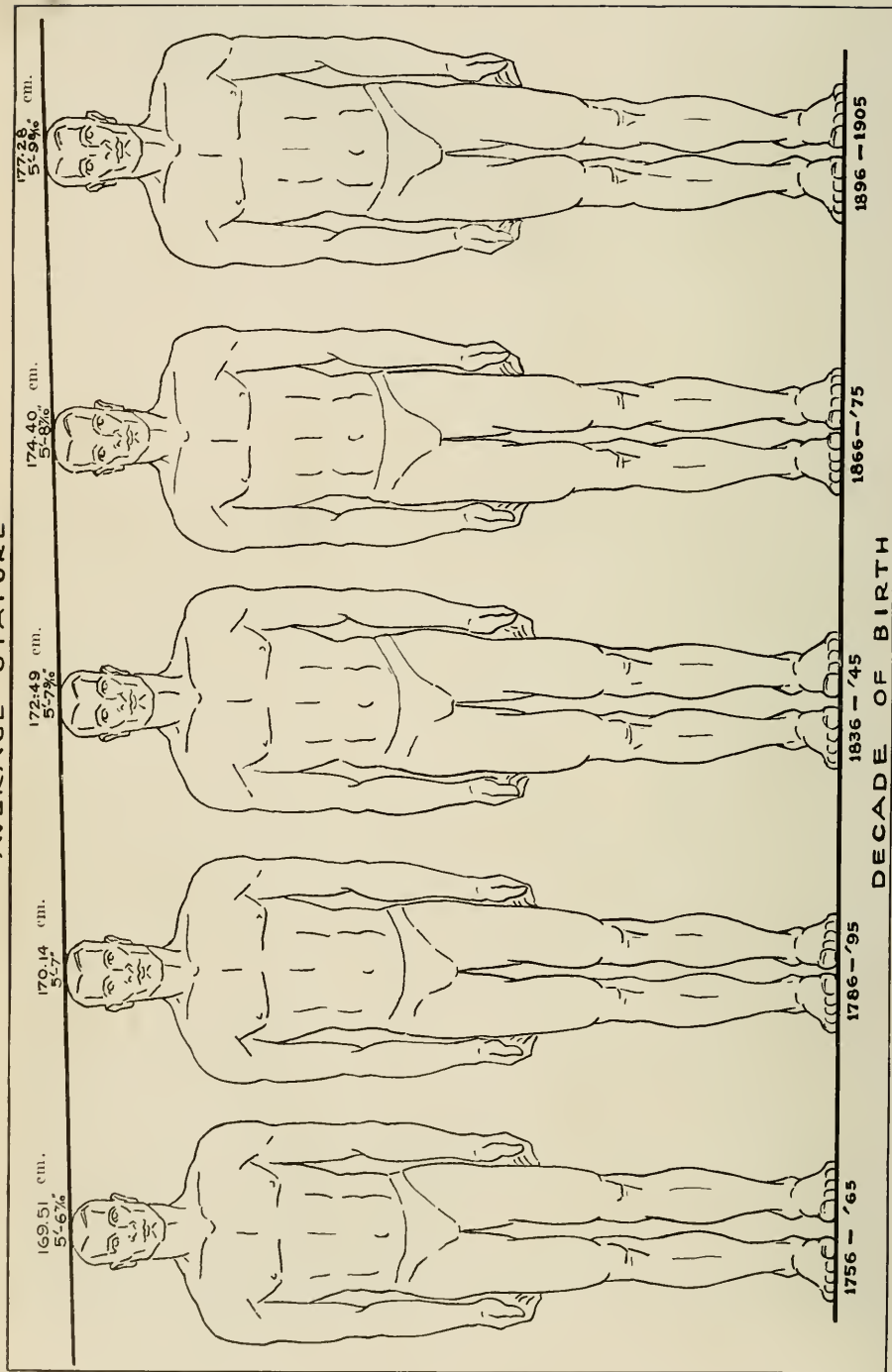
It is rather difficult to determine whether the rate of man's evolution has been slower or faster than that of other creatures. Certainly in contrast with some of the lowly molluscs, such as the brachiopods for example, man has been a veritable greyhound, nor has he, compared with the horse, shown any tendency to lag. We must conclude that



A PRIMATE TRIUMVIRATE

Gorilla, Australian aborigine, and modern European, these three represent important stages in human evolution. Note in the sequence from gorilla to European the expansion of the frontal region, the reduction in the bony ridge above the eyes, the increasing prominence of nose, and the marked recession of the jaws

AVERAGE STATURE



More Than a Century of Progress.—Stature has been increasing in many parts of the world. The above diagram illustrates this process among the undergraduates of Harvard who are represented by the three figures on the right. For comparison the two figures on the left are also given. These latter are the averages of New England soldiers and sailors of equivalent ages

man's capabilities for advancement are excellent, but that evolution is a slow process requiring great stretches of time to manifest itself. If, therefore, my picture of the average man of 501,933 A.D. does not conform to your esthetics, you can at least take comfort in the thought that the man of 6933 A.D. will be but little different from what he is today, and for most of us that is far enough ahead to worry about.

THE DISTINCTIVE TRAITS OF MAN

The most striking changes which have occurred in the evolution of man from a four-footed (or four-handed, if you prefer) primate to his present proud estate are the marked increase of the brain and the assumption of an upright posture. Upon these developments a numerous series of subsidiary changes are dependent. But these two, upright posture and highly evolved brain, more than anything else distinguish man anatomically from his anthropoid predecessors. And of the two I am inclined, perhaps cynically, to hold that the upright posture is the more distinctive. From that remote day in the past when our ancestral anthropoid stock left off using its fore-limbs in locomotion and stood up on its own hind legs the upright posture has remained essentially the same. Although the structure of those enterprising primates had been, to some degree, prepared for such an upward step by a long arboreal tutelage, nevertheless one can readily apprehend the repercussions which that event would have on numerous skeletal traits and internal organs, and one can appreciate the pains of adjustment which would follow. For this new mode of progression made it necessary among other rearrangements, for the foot to develop into a more firmly knit and resistant mechanism, for the pelvis to take on an increased weight-bearing function, for the thorax to become flat-

tened and for the internal organs to be suspended in the longitudinal axis of the body. The point is that although all sorts of accommodations, some of which are still imperfect, were slowly being made in the structure of these early bipeds, the very stimulus to these gradual alterations remained unchanged. In other words, man having achieved this step, did not proceed further along that road for the simple reason that he couldn't. Once the upright posture is attained one can't go on becoming more and more upright.

The brain, however, underwent no such circumscribed development. It merely expanded slowly. And while the upright posture has remained fixed, the brain, on the contrary, has continued to increase in size and complexity. For this reason the brain and its enclosing skull are areas where the most significant changes have taken place during the more strictly human history of man.

A LARGER BRAIN

I can venture, therefore, with some confidence to predict that man in 500,000 years will continue to be an upright creature, and with some hesitation that his brain will be larger. The reason for my slight hesitancy with regard to the expansion of the brain in the near future (for 500,000 years is but a few days in man's phylogenetic existence) is that there are some indications that the quality of the brain may improve without a concomitant increase in size. Moreover, Keith has shown that among the Bushmen, for example, the cranial capacity of their ancestors was much greater than is their own. Furthermore, Rhodesian man and some of the Neanderthal burials of 50,000 years ago had skulls the size of which were equal to if not greater than our own. But in general the tendency from *Sinanthropus* and *Pithecanthropus* to modern man has

been for the brain to expand. Actually the cranial capacity of *Pithecanthropus* was about 900 cubic centimeters (roughly 1000 cc. in *Sinanthropus*), appreciably larger than the average for gorillas, 500 cc., and than that for chimpanzees, 400 cc., but much smaller than we find commonly among Europeans, 1450 cc. If we accept the recent estimates that *Pithecanthropus* lived at the end of the Pliocene or the beginning of the Pleistocene, a matter of 1,000,000 years ago, we might, by the assumption of a constant rate of increase and with the aid of simple arithmetical processes, arrive at a capacity of 1725 cc. for our future man 500,000 years hence. But this need not call up a picture of a balloon-headed individual. There are men to be met without special comment on the streets today whose skull capacity reaches and even exceeds this figure.

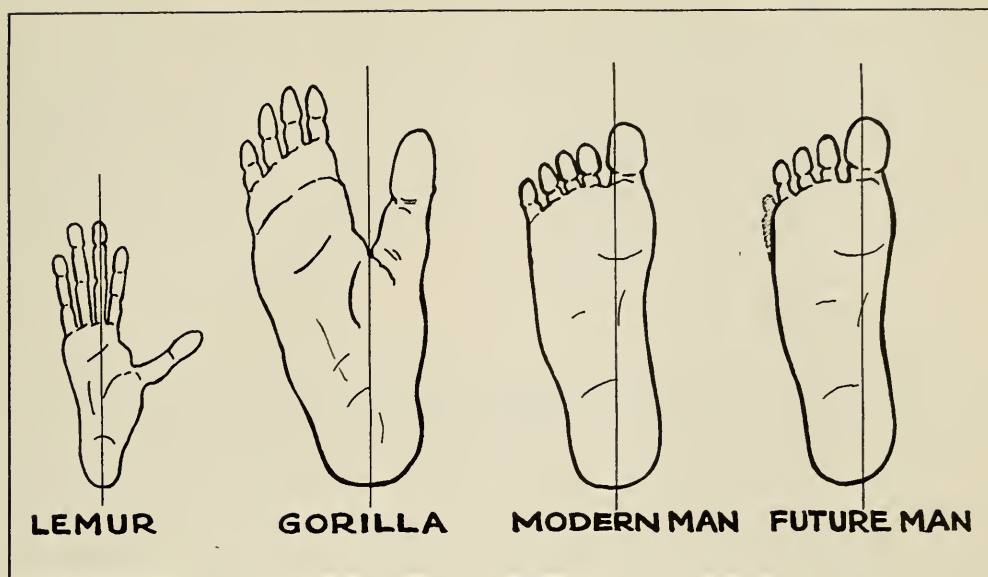
CHANGES IN SKULL SHAPE

Professor Arthur Thomson investigated some years ago the effect on the skull of an increased capacity. He found by a simple experiment that if the base of the cranium were kept constant, the cranial vault tended to become rounder as its capacity expanded. The mechanics of his experiment have been amply supported by a number of statistical studies yielding high correlations between head form and cranial capacity. The corollary of these investigations is clear. If the capacity remains constant and the skull base decreases in length we have in effect the same result as increasing skull capacity on a fixed skull base. Actually the modern European skull base reveals a marked shortening. In the Neanderthaloid skull, known as *La Chapelle aux Saints*, the skull base is 123.4 mm. long, in the adolescent *Le Monstier* specimen of the same stock it is 124.0 mm.; whereas in the succeeding Upper Paleolithic males it averages 104.8 mm. and in modern Europeans from about 94 to 102 mm.

This reduction is convincingly paralleled by a rise in the cranial index. Moreover, there are other signs indicating the way the evolutionary wind is blowing. Recently attention has been focused on the increasing brachycephaly or round-headedness in various parts of Europe. Parsons has noted this phenomenon in modern England where there can be no question of a recent brachycephaly introduced by an invading population. Fischer has similarly reported for southern Germany. We can, therefore, assume that our hypothetical "*homo futurus*" will have not only a larger head or brain case but a rounder one as well.

OTHER CHANGES IN THE SKULL

Pari passu with the expansion of the skull, which I anticipate will continue into the future, there has been a refinement of the modeling of the skull. The angular and crude primitive cranium has gradually been converted into a smoother and more gracile one. I shan't go into all the ways in which this has taken place. That would require a volume. But an important change readily noticeable to the average observer has been the reduction of the prominent bony ridges over the eyes, which in anthropoids and fossil men resemble a heavy bar. At present the female of the human species tends to have a brow that is more or less vertical and smooth above the eyes; whereas in the male there is a moderate swelling above the root of the nose in the region called glabella. To either side of this glabellar area vestigial ridges of bone still persist in the modern male. It is a well marked sex difference and is clearly apparent. With the aid of our evolutionary series we notice that there has been a consistent expansion of the frontal region and a smoothing of the brow as we advance from the primates to modern man. In this respect the female has always been in advance of the male and has



THE FUTURE OF THE HUMAN FOOT

The shifting of the line of leverage in walking and the greater functioning of the big toe have reduced the fifth or little toe in the human foot to a minor and negligible rôle. The day may come when we shall have only four toes

pointed the direction in which he has traveled. The ladies may take pleasure in contemplating that it will have taken the males 500,000 years to attain the smoothness of brow which they now possess. As for the females themselves, if a sex difference in the frontal region of the skull is to persist, they will develop infantile brows—slightly bulbous.

It was the renowned Metchnikoff, I believe, who considered the digestive organs a grossly over-developed system in the human economy. Certainly, many of his less accomplished successors predict the future man with a very reduced digestive apparatus, sufficient only to absorb highly concentrated food-pills with which they fancy man will content himself. Perhaps even such a vestigial digestive tract may be dispensed with altogether if man ever becomes indifferent to food. In that sad day the essential nutriment of life might then be injected directly into the blood stream. But I cannot accept this dismal future. The delights of the table are too pleas-

ant to be lightly eliminated in favor of the sterile and joyless consumption of food pills. I can perceive no diminution in man's appetite—if anything he eats more than primitive man—and certainly I have yet to know a healthy man who shows even the faintest inclination to relinquish the sensuous and delicate enjoyment of solid foods. Therefore I leave you your stomach and its appurtenances.

But even though our digestive system remains intact, one adjunct to it is undergoing modifications and will continue to do so. This is the dentition. No vertebrate is afflicted with such extensive dental decay as is man. Hardly a child among us reaches puberty without some decay developing, few adolescents attain maturity without loss of teeth from caries, and a large number of adults only have teeth at all by the constant vigilance of the dentists.

Unfortunately decay, or caries, is not the only evidence of a serious readjustment going on in our dentition. This is

seen also in the frequency with which our teeth are mal-erupted. Twisted teeth, impacted molars, faulty alignments and mal-occlusions are too common to be lightly dismissed. They indicate a deep-seated force at work which is generally affecting the population. Indeed, so numerous are the children suffering from these mal-eruptions that there has grown into being a branch of dentistry, orthodontia, devoted expressly to the correction of these dental faults.

DENTAL MODIFICATIONS

But this is not the whole story of the degeneration of the human dentition. In still other ways it manifests itself. I shall mention only two more. One is the increasing suppression of the third molars or wisdom teeth. Not only is the age at which it normally erupts, 18 to 20, being pushed back later and later in life, but in many people they are absent in whole or in part. The second is the constriction of the jaws. It is obvious that the crowding of the teeth and the constriction of the jaws may be associated, but not always is this the case.

WEAKENING TEETH

One cannot help being convinced that all this evidence is symptomatic of a fundamental process which may in time be responsible for considerable alterations to our dental equipment. I do not propose to enunciate a dogmatic generalization to account for this situation. Controversies on the nature and cure of dental decay have flourished for generations among those interested in teeth. Decay has been attributed to hyperacidity, to endocrine dysfunction and to diet, among other factors. No doubt the situation is a complex one and the superficial causes may be as varied as the manifestations they produce. But one cannot but be impressed by the fact that the dentition is an area of weakness. My guess

is that the teeth are, to a large extent, losing their function and consequently becoming less vigorous and resistant. In other words, they are readjusting themselves to the changed demands upon them. This in itself reduces them to a state of relative non-resistance which makes them especially prone to secondary attacks—endocrine dysfunction, faulty diet and hyperacidity. In their weakened state they are unable to withstand attacks that in lower forms are easily resisted. Perhaps I can make my idea clearer by comparing them to an army which, kept in constant and full use of its powers, is able to put up a good defense against its enemies. But suppose such an army were not systematically employed but took its ease in comfortable barracks and never exercised its warlike functions. Then an attack would decimate it. So the teeth have lost their resistance and so they capitulate to the onslaughts of their enemies.

FEWER AND SMALLER TEETH

We may see this perhaps more clearly by examining the toughened teeth of anthropoids and early man. Of course, decay is not completely unknown even among these creatures, but it is rare. The third molars do in most cases erupt complete and sound, and the position and alignment of the teeth in their serried arches would delight the heart of an orthodontist, accustomed to the misshapen jaws of his patients. Even among present-day Eskimo who alone among living people make full use of their teeth the same beauty of dentition is present. From the primates to modern man we perceive a progressive recession of the jaws, a decrease in the size of teeth, a loss in number, and an increase in mal-eruptions.

We are now in the position to predict the future condition of the teeth of our gradually emerging man. Since it is improbable that we shall return to the tough,

resistant food on which our predecessors thrived, the chances are that our dentitions will continue to deteriorate. Future man will have lost his third molars, many of them will also show reduced or absent lateral incisors. The jaws will be smaller and what teeth are present will be diminished in size.

This predicted diminution of the size of the jaws and the teeth goes hand in

facial structure for attachment. Since it is well known that the face has gradually become reduced in length and in horizontal projection, it follows that its field of attachment on the skull base has shown a correlated reduction. Other things being equal, a shorter cranial base means a rounder head. But the decreasing length of the skull base and its facial attachment has another significance here.



THE DECAY OF THE TEETH

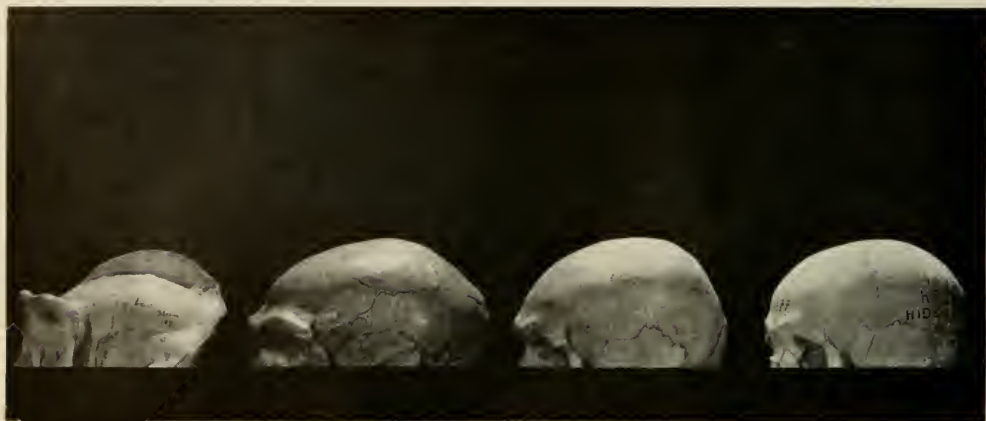
The dentition on the left is that of a gorilla, the middle one is that of an Australian aborigine, and the one on the right a modern European. Note the reduction in size of the jaws, of the teeth themselves, and the advanced decay in the teeth of the modern man

hand with a reduction in the muscle masses which control the masticatory movements of the mandible. Since the cheek bones and their lateral arches serve to enclose these muscles and to take up the pressure created in chewing, it is apparent with a less vigorous mastication and a decrease in the muscle mass that the facial parts will likewise undergo a modification. "*Homo futurus*" will have, therefore, in addition to his other characteristics, a relatively smaller face.

I mentioned previously that the skull base has shown a marked decrease in modern man. There is a good architectural reason for this. The base of the skull is intimately associated with the face which is linked to it. In fact, it might better be said that the base of the skull is determined by the needs of the

It calls attention to the marked recession of the face which is so definite in man's phylogeny. In the primates the jaws project like a muzzle and are labelled prognathic. But in modern Europeans the profile of the jaws has receded to a vertical line dropped from the root of the nose, a condition known as orthognathism. From what has been prophesied already for the man of the future it is clear that this recession will be emphasized to an even greater degree.

Let us turn to another attribute of our average man of 500,000 years from now. This future being will be taller than we are. My reasons for this belief are in reality simple. It is, in the first place, well known that in many forms of evolving species there is a definite increase of size during the course of their evolution. The



CHANGES IN THE CRANIUM

From gorilla on the left, through Neanderthal man, Australian, and European, one can observe a progressive modification of the brow. The vestiges of the heavy brow ridge, characteristic of lower primates, are still to be found in present-day males

giant reptilian forms of the Mesozoic—the dinosaurs, the brontosaurus and their relatives—all began as small forms and gradually put on weight. One of these ponderous creatures might well have looked back to its phylogenetic youth and sung with sadness:

"Fading is the taper waist,
Shapeless grows the shapely limb,
And although severely laced,
Spreading is the figure trim!
Stouter than I used to be,
Still more corpulent grow I.
There will be too much of me
In the coming bye and bye—
There will be too much of me
In the coming bye and bye."

Indeed this phenomenon is a common one. We see it again in the phylogeny of the horse, the camel, and in various other mammals. In the primates, too, the sequence runs from the small lemuroid creatures to the hefty gorillas. Now, in man it has likewise been observed that the stature of early man is often near the upper limits of pygmy stature whereas we overtop them considerably. Projecting this trend into the future we must anticipate an increasingly taller and bigger man. But there is other evidence to support this prophecy. Everywhere in

Europe and in America where records have been maintained over a period of years, there has been a consistent accretion to the average stature. Investigators of this phenomenon have reported such an increase in Switzerland, Germany, Sweden, Denmark, Holland, England, and the United States. It would be tedious to reproduce here all the figures which corroborate this general phenomenon, but we may illustrate it by a few examples. In the Canton St.-Marie Vesubie, in the Maritime Alps, the average stature has increased from 155.5 cm. in 1792 to 165.0 cm. in 1872. In Norway an increase has been reported from 168.6 cm. in 1850 to 170.7 cm. in 1905. Perhaps the best illustration of this remarkable increase in stature, and the most convincing, is the study of successive generations of Harvard students which has recently been issued by G. T. Bowles. Dealing with sons, fathers, and in some cases grandfathers, all belonging to one class in society, he was thereby able to eliminate such factors as social and economic influences. Furthermore, there was no question here of differences in stock. The results unequivocally support the findings already mentioned.

The present generation is about 3.55 cm. taller than their own fathers, younger sons are somewhat taller than their elder brothers, and the fathers are taller than the grandfathers. Just exactly what is causing this no one knows precisely. None of the numerous reasons suggested by the fertile imagination of a number of workers seem to be completely satisfactory. A fresh opinion from Switzerland proposes that the intensity of modern life stimulates the vegetative nervous system which in its turn reacts on the increase of growth. Hooton has ingeniously suggested that modern hygiene and medicine are able to nurse to maturity the rapidly growing tall children who formerly tended to be eliminated. But whatever the true nature of this change—whether nervous or medical—since I see no permanent nor complete relapse to barbarity with a consequent return to a simpler life and a destruction of medical science, I therefore predict a taller man in the future.

I frankly halt at attempting to estimate the number of his inches. As a prophecy this should please many of my patient readers, but I do not see it as an unmixed blessing. As far as I know, there is no reason why a taller man is mechanically a better one. As a matter of fact, a short man is probably more efficient in the use of the energy which his body creates than a tall one. But esthetically the tall men are preferred, at least, among Europeans and Americans, and perhaps in a civilized nation Art should prevail.

We now have the major aspects—the high lights—of the portrait of our future man. At any rate these are all I have space to expand upon. I shall now turn to a few of the details which give character and individuality to our drawing.

If any one of my readers happens to be a chiropodist who has had abundant opportunity to examine minutely and professionally a large number of feet, he will bear me out that the little toe is frequent-



THE SKULL BECOMES ROUNDER

Seen from their tops, the skulls of Pithecanthropus, Neanderthal man, Australian, and European show an increased breadth relative to their length. Although many modern skulls are as long and narrow as the earlier types of man, the phylogenetic tendency has been toward a broadening of the skull

ly very little indeed. Sometimes this fifth toe even lacks a toe nail, or it may have only the merest suggestion of one like a tiny claw—not a flat nail. Unfortunately in this respect I cannot compare the present state of affairs with the condition of the little toe in early man because his toes are not preserved for our inspection. But we can study the toes of the anthropoid feet nearest man's—the gorilla's. Here we find a well developed little toe with a complete nail. From this we deduce that man's little toe has become progressively smaller and more useless.

THE LOSS OF THE FIFTH TOE

An analysis of the mechanics of the foot reveals why this is so. In the primitive primate foot the line of leverage in walking passes through the middle toe, which symbolized its primacy over the other toes by its greater length. In the course of primate evolution the line of leverage shifted to a position midway between the big and the second toes as a result of adaptation. In man we find that the line of leverage has remained in this position or even moved over entirely to the big toe. As a result of this greater weight bearing and mechanical functioning the big toe has grown to be the largest of all the toes with a progressive decrease in size and function as one moves to the little toe. The increasing loss of function in the little toe is revealed by the fact, which was mentioned above, that in a large number of people it has degenerated to a tiny digit often without a nail or only the merest vestige of one. This suggests the probability of its future disappearance. But since nature is slow I dare go only so far as to predict that the little toe of our future man will be even littler and that in many it will perhaps be simply a suggestion of a digit. This loss of toes, however, need not surprise us, for it is a phenomenon well known

in the evolution of a number of common mammals, such as the horse, cow, camel, pig, etc.

We are now coming rapidly to an end of this portraiture, but I wish to complete the picture with a few words on the hair of our future man. It is well known, or more precisely, it has been observed by some investigators that baldness is much more frequent among the highly civilized races of mankind than among the primitive people of nature. Can you, for example, think of a bald-headed Indian! I suppose some have existed, but it is a phenomenon as rare as a full-bearded Indian. Similarly you would have difficulty finding a bald-headed Polynesian or Melanesian. But among Europeans many of our young men at thirty are already well along the road to baldness. In India, too, this phenomenon is common. Although here I am on treacherous ground, I hazard the guess that with advance in civilization the incidence of baldness will increase, and that in the future of 500,000 years from now it will not only appear earlier but more extensively.

A RECAPITULATION

Finally, we shall give our future man less body hair than he now possesses. Man varies widely in the amount of body hair with which he is covered. But among all groups he is relatively glabrous, or hairless, when compared with the anthropoids. Indeed, it is evident that in the course of human evolution the pelt has constantly diminished. This process of depilation has advanced farther in some races than in others. The Mongoloid people, for example, are very glabrous as are the Negroes. Only the white stocks have lagged behind in this respect. Therefore it seems but natural to suppose that European man will continue along the line of progressive loss of body hair.

To sum up our prophecies on the future man we may impressionistically describe

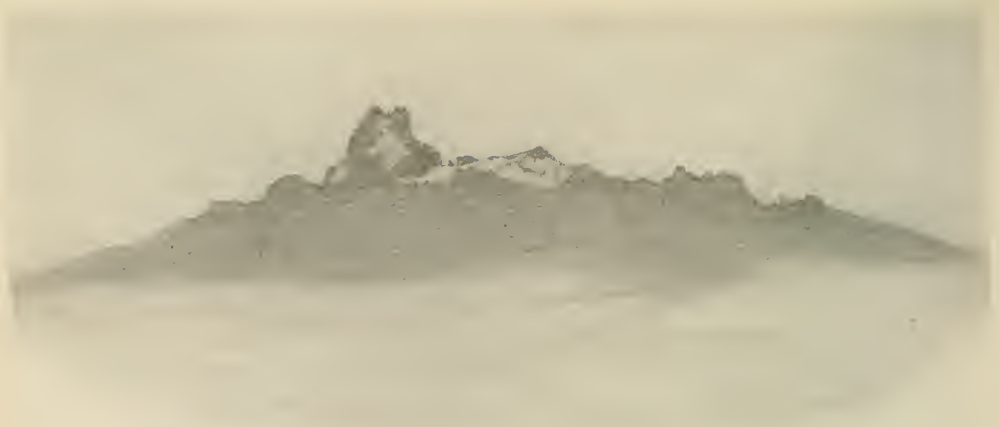
him as taller than we, with a more capacious and rounder head, fronted by a more vertical and smoother brow. His face will be smaller and more recessive in profile. The teeth in his jaws will be reduced in number and will also be smaller in size. In particular the third molars, but also in some cases, the lateral incisors will be absent. Caries or dental decay will continue to be a serious problem requiring constant supervision to keep in check. Some representatives of this future race will walk on four-toed feet and many will in early adulthood have become bald. The body hair will be less abundant,

perhaps reaching the condition of hairlessness found in Chinese and Negroes.

These, then, are some of the characteristics which I predict for the man of the future. But in addition to these differences from ourselves, there will be many similarities, so many in fact that you would have little trouble in recognizing him as a fellow-member of the same genus. But were you miraculously preserved to that far distant future, I am afraid that you would need to seek among the phylogenetic laggards and the "primitive" people for somebody exactly like the folks back home.



THE ADVANCE OF FUTURE MAN BEYOND PRESENT-DAY MAN MAY BE JUDGED, PERHAPS, BY REFLECTING ON OUR OWN EVOLUTION FROM THE STAGE REPRESENTED BY THIS NEANTHERDAL MAN, FROM A PAINTING BY F. L. JAUQUES IN THE HALL OF THE NATURAL HISTORY OF MAN, AMERICAN MUSEUM



The Peaks of Kenya from the South. Sketched by W. R. Leigh

UP KENYA IN THE RAINS

A Visit to the Second Highest Mountain in Africa Which, with Its Snow Fields and Glaciers, Lies Ten Miles South of the Equator

IN TWO PARTS—PART I

By JAMES P. CHAPIN

Associate Curator of Birds of the Eastern Hemisphere, American Museum

THE crowning glory of Kenya Colony is a great volcano, long extinct and eroded, though still rising to 17,040 feet. From this mountain is taken the name of the country that once was British East Africa. First seen from a distance by the Missionary Krapf in 1849, Mount Kenya remained largely unexplored till 1887, when Count Teleki made an ascent to nearly 14,000 feet. Five years later Dr. J. W. Gregory went 2000 feet higher, and in 1899 the highest summit was finally conquered by an expedition led by H. J. Mackinder.

Looking back into boyhood, I recall that I read of Kenya—or Kenia, as it is often spelled—even before birds began to attract my attention. Rider Haggard's story *Allan Quatermain* held me spell-bound as I followed the old elephant hunter's trip up the Tana River to a mission just southeast of Mount Kenya, where lived the rugged Mr. Mackenzie and his wife and daughter. Excitement increased with the courageous attack

upon the Masai who had kidnaped the girl, and the exploits of Umslopogaas, Zulu artist with the battle-ax.

Haggard's romance was published in 1888. How different is the Africa of to-day from that of *Allan Quatermain*! Instead of canoeing up the Tana River, DeWitt Sage, Frank Mathews, and I had come by railway to Nairobi and by Ford truck to the eastern base of Mount Kenya. We were being entertained at a mission, in charge of a Scotsman, to be sure, but in a house lighted by electricity. Doctor Irvine was a medical missionary, with his wife and children, and had, in addition to an excellent hospital, a church and a trade-school. To aid in the church there was a native minister, for the hospital an English nurse, and for the children's care Miss Lemaire, who was Swiss.

To me Mount Kenya was already historic ground. Twenty years before, my old friend Herbert Lang had collected mammals there for our Museum. In the

same year, 1906, Carl Akeley, whom I had seen only recently in Nairobi, began hunting elephants on the mountain for his celebrated exhibits in the museums of Chicago and New York, an enterprise which nearly cost his life. In 1909 two other friends, Doctor Mearns and Edmund Heller, had likewise collected on Kenya during Colonel Roosevelt's expedition.

Since that visit of ours in 1926, airplanes have circled over the peaks of Kenya, taking photographs, and automobiles have been driven up it to an altitude of 10,000 feet. Such is the rapid progress of transportation in Africa since the World War. Nevertheless, I am happy that we had to walk up Mount Kenya. Afoot one sees a country as in no other way. Instead of crushing unseen flowers under whirling tires, we could step aside and examine them at leisure. Songs of birds were not drowned in the explosions of gasoline, and views of peaks when the

clouds lifted could be prolonged till they really sank into the memory.

Of course we had to reckon with the weather. We were in for some wettings. Kenya Colony has well-marked seasons, with no great change in temperature, but two dry and two distinctly wet periods in the year. May is one of the rainy months, and if you value comfort, don't go to an equatorial mountain except in the dry season. During a little over a week on Kenya we had scarcely a day without rain at some hour, if not for many hours. Rain when you are cold is the worst.

In other matters there was no fear of difficulty. Doctor Irvine had been advised of our coming. His father-in-law, Mr. Ernest Carr of Nairobi, was an alpine enthusiast who had already placed two wooden cabins on the mountain, and he had given us a diagram with all the important landmarks and their altitudes, along the path we would take up the eastern slope of Kenya. For these arrange-



KENYA FOREST AT 7500 FEET

The road up the eastern slope runs right through the center of the picture

ments and much sound ornithological advice we were indebted to Doctor van Someren of Nairobi, the best friend one could hope to find.

Chogoria Mission is at about 5000 feet, near the Mara River, which flows out of the Kenya forest and eventually feeds the Tana River. The country about it was no doubt deforested rather recently by the natives, who just here are of the Mwimbi tribe. The road from Embu had dipped in places to 4200 feet, where wild date palms along the streams indicated a truly tropical climate. We were to make one of those journeys often described as climbing from the tropics to the arctic, treading on contours and isotherms every little way, and beholding life as it disappears under the perpetual snow. I confess that I was impressed; I would keep my eyes open. I had grown to prefer this kind of adventure to assaulting a Masai encampment.

Doctor Irvine sent a call for twenty porters to take our camp equipment upward. The standard wage had hitherto

been one shilling a day. All the applicants demanded two, clearly they had formed a union. The Doctor advised me to offer one and a half, and the compromise was accepted. As headman we engaged Mtwámuthára, a bright young Mwimbi with a bundle of hair tied down his forehead, like one of Martin Johnson's best models.

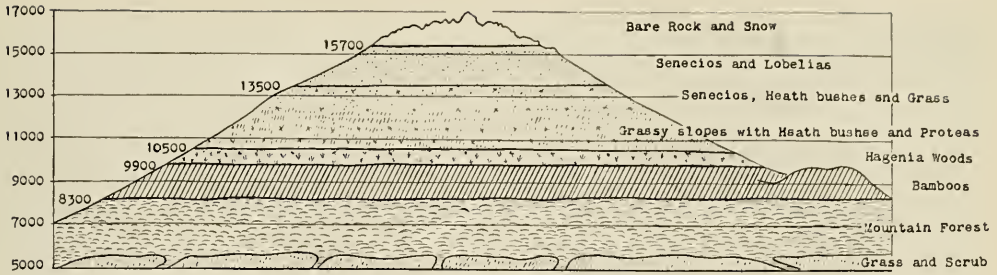
The way these men walked up Kenya with their heavy loads put us white folk to shame. Rain often dampened their spirits, but grade or altitude meant nothing. When I think of the old cotton blankets and small tents, all we could lend them as protection, I am abashed. Cornmeal mush with a little ghee, otherwise stale native butter, was practically all they had to eat.

We are told that Kenya is often visible from Nairobi, eighty-five miles away; but here were we, at less than twenty-two miles, and we had to wait till the second day at Chogoria to see its peaks. A heavy rain early that morning stopped at sunrise. Then from 6:15 to 8 A. M. the higher



EVENING IN CAMP

Frank Mathews plays his flute, while DeWitt Sage makes our large canteen serve as a drum to accompany him



VEGETATION ON THE EASTERN SLOPE OF KENYA

Here the lower mountain forest is very extensive, although on the northern side it is almost wanting. At higher levels the conspicuous plants—bamboos, hagenias, heaths, and tree-senecios—are distributed in altitudinal zones

summits, all white with fresh snow, remained in full view. Afterward the clouds closed in again; and we were within three and a half miles before seeing them once more. Our Mwimbi guides never called the mountain Kenya, but only Kilinyaga. The name we use was given by Krapf, who wrote that the Wakamba tribe, living off to the south-east, spoke of the mountain as "Kima ja Kegnia" or "Mount of Whiteness."

From Chogoria there was still another mile of roadway up to a rest-house belonging to Chief Mbogori, so there we went and parked the truck, preparatory to starting off on foot. On the 9th of May, after waiting for a rain to stop, we left the comforts of civilization and took up the old method of African travel, now required only in out-of-the way spots.

First a short walk through old fields, tall bracken, and scrub, with little pink clovers in the path, then we entered a somber forest that resembled strangely the lowland forests of western Africa. There were lianas hanging from the trees, and rather thick undergrowth. Ferns were numerous on the boughs, and beard-lichen hung higher up in some of the trees.

Very soon we had to cross the swift-flowing Mara River on a couple of thin tree-trunks, admiring the tree-ferns nearby, and noting two gray wagtails that fled at our approach. Some very large balsams with pink-and-white flowers

grew from the water, and made me think of my herbarium. Ahead, we began to ascend gradually—or sometimes not quite so gradually—along a muddy footpath, and for the next five hours this continued, save for one short descent into a ravine cut by the only other stream we crossed that day. Here were more tree-ferns. Forest of the sort mentioned continued to an elevation of about 7500 feet. Then the trunks of the trees became more moss-covered, the beard-lichen draping their upper branches more abundant, and the undergrowth more open. Some limbs were heavily draped with epiphytic ferns. The largest trees now were African yews (*Podocarpus*) with leaves too broad to suggest their allies in Europe.

Much of botanical interest I certainly overlooked. My eyes were "peeled" for birds. For years I had been admiring skins and colored plates of white-starred robins (*Pogonocichla stellata*). To see them alive you must go to cool forests in Africa. The "star" is a silvery white spot on the foreneck, between the blue-gray throat and the golden yellow breast, scarcely visible in life, unless possibly the bird makes a point of showing it during courtship. Females have the spot as well as males.

Robins in Europe and Africa are small thrushes, not very similar to our so-called American robin. In the highlands of Kenya Colony dwells a larger thrush, a



TREE FERNS IN A GULLY

They grow only where the ground is especially wet, and reach a height of 20 feet

close relative of our "robin," with an orange bill, but the plumage somewhat duller in tone than with ours. This bird (*Turdus olivaceus elgonensis*) we also saw near the Mara River, and found it relatively shy. Two other thrushes belonging to the genus *Geokichla*, with even more retiring habits, also live on Kenya. One of them (*G. gurneyi chuka*) we saw only by following its clear ringing song through the tangled forest.

Characteristic of African forests, from sea-level to 9000 feet, are greenish bulbuls, somewhat like thrushes, but with rounded wings and shorter feet. Their songs are less melodious, and their calls often harsh or nasal. One of the most characteristic forest birds on Kenya and Ruwenzori is the gray-headed *Arizelocichla kikuyuensis*, which, in trying to sing, seems to say "Don't, care if you don't" in unpleasant nasal tones.

Besides looking for birds, I had to keep

moving, and occasional showers were annoying. A band of black-and-white *Colobus* monkeys, which had been giving their prolonged rolling growls, the least monkey-like sounds one can imagine, were seen running off through the trees. Toward 7900 feet we came to some old open spaces that seemed to have been cleared by natives long ago. In this quarter of the mountain we learned of no human settlement today above 6000 feet. The clearings were carpeted with herbaceous plants such as grasses, sedges, braeken, alchemilla, wild geraniums, little blue violets, and pale pink clovers. Plants of northern affinities were thus in evidence; but since the growing season is not restricted to a short summer, one does not find the solid fields of blossoms that adorn most northern mountains in June and July.

To the northeast rose a rounded moun-

BOLE OF A LARGE *PODOCARPUS* TREE

Probably the most important timber tree in the East African highlands. Fortunately Mount Kenya is a forest reserve



THE LOWER EDGE OF THE KENYA FOREST

View from near Mbogori's rest-house, with the mountain in the distance

tain, Ndua, a little over 9000 feet high, but that was a mere bump on the flank of Kenya. From Chogoria to the snow-line, Mr. Carr had told us, there are fifteen hours of march. We had no intention of keeping up with the record, so in one of these open spaces we made our camp for the night. As the smoke of the camp fires mingled wearily with the cool, misty air, we looked about for more birds.

It was here that I made the acquaintance of the mountain buzzard, a dull brownish "hawk," as it would be called in America, *Buteo oreophilus*. It does not descend to the lowlands, nor does it feed mainly on rodents, like so many allied species. Instead it appears to specialize in chameleons, those slow-moving arboreal lizards with projectile tongues.

As I stalked one of these buzzards perched on top of a lichen-draped tree, a ground-dove (*Aplopelia larvata*) came and sat for a moment on a bough only twenty-five feet away. During the afternoon we had had several glimpses of

these small, brownish doves as they flew up and made off through the forest undergrowth. A few olive pigeons (*Columba arquatrix*), fruit-eating birds of the higher trees, flew across over the clearing. They are as large as domestic pigeons, dark gray and plum-color, with much whitish speckling. Their flesh is so bitter as to be nearly useless for food, and it has been claimed that when feeding on berries of the African yew they become positively poisonous.

One of the rarer birds of Mount Kenya is a forest-dwelling ibis of dark coloration, *Lampribus olivacea akeleyorum*, which was discovered on Kenya by Carl and Delia Akeley in 1910. Even today there are but seven specimens in museums. As night fell, two ibises were seen winging their way across the clearing with loud "complaining" calls. Had they passed close enough, I might have added one of them to our collection, for no doubt they were of this desirable sort. The common hadada ibis is more attached to rivers, and



A HALT DURING THE SECOND DAY

These sunny spots offer temptation to sit down for a smoke and gossip. The men had earned their bit of leisure

ibis is by no means so rare as museum material might suggest.

With darkness came another heavy rain, but after a strenuous day afoot and some routine work after dinner, sleep asks no invitation. Loud and reiterated croaking by the tree-hyraxes could

seldom if ever ascends to the upper slopes of forested mountains. Later in our climb we heard similar ibis-calls at dusk near an elevation of 10,000 feet; and along the path between 6000 and 9500 feet we picked up a few scattered *Lampribis* feathers. So we may be confident that the Akeleys'

not keep us awake.

The next morning was cloudy and damp. Soon we were traversing another clearing called Maironi, near 8500 feet, from which occasionally a good view is had of the mountain ahead. Here one notices a rose-pink immortelle growing more than knee-high. More important, and beautiful in another way, were the mountain bamboos (*Arundinaria alpina*) which first appear as scattered clumps of stunted plants at about 8200 feet. Bamboo being a giant grass, it does not increase in thickness by adding rings of wood, and the thinness of the stalks near the upper and lower limits of its range must be an indication that conditions there are less favorable to its development than between 8700 and 9600 feet, where the stalks are all very thick—three to four inches—and rise to a height of fifty feet. In the dense shade of Kenya's marvellous growth of bamboos few other plants thrive. The ground is carpeted with dead bamboo foliage and the huge bracts that fall from the sturdy young bamboo shoots.

The bamboos of Kenya are larger and more exclusive than those of Ruwenzori. Here and there amid them rose a few other large trees, often of *Podocarpus*. The plantain-eaters (*Turacus hartlaubii*), with wings flashing crimson when they



A SPIKY BOUQUET

The thistle stalk, two feet tall, is surmounted by a cluster of purplish-pink flower-heads

flew, perched in such trees rather than in the bamboos. So presumably did the parties of squawking green parrots that passed over a few times. This parrot (*Poicephalus gulielmi massaicus*), here a montane bird, is an eastern representative of a species common also in western lowlands. From the bamboos themselves came a rather weak silvery song which we traced to *Chloropeta similis*, a small green-and-yellow bird. With the flattened bill of a flycatcher it combines many other characters of a warbler, and hops actively about in the leafy branches.

We were following a path, and to leave it was difficult, except where elephants had broken a way. Fallen bamboo stalks were everywhere. In a place like this the track has been described as suggesting that someone had passed along plunging buckets into the mud. The trampling of elephants of course had done it, and once we lost our way for a while by following their trails instead of the less evident human route. Buffalo likewise are common up to the bamboo zone, but as usual we failed to see the larger creatures in our search for the smaller ones which the majority of visitors neglect.

This day was the driest of our trip. I do not recall any shower, and in mid-afternoon we came abruptly to the upper edge of the bamboos. We had been puffing up a steep slope, and then near 9900 feet we suddenly came out amidst clumps of heath bushes and grass, startling some little gray-brown birds which showed white outer tail-feathers as they flew off. To my mind



GIANT FISHING RODS GOING TO WASTE
Toward 9400 feet the bamboos reach their maximum size and density

came our American juncos, or snow-birds, which nest on mountains. A second look, however, showed them to be chats or small thrushes, *Pinarochroa sordida*, which are characteristic of the alpine meadows of Kilimanjaro, Kenya, and the mountains of Northeast Africa.



THE UPPER LIMIT OF BAMBOOS

Some of them still show in the background, but from here on the country is all relatively open



THE FIRST CAMP ON KENYA

In an open glade at 8000 feet,
an unkempt lawn in the midst
of forest

tree-line on Kenya or Ruwenzori. Above 10,600 feet on Kenya we saw no more trees save groundsels (*Senecio*) with stout, woody stems, some of them still standing at 15,000 feet.

A little above 10,000 feet, after traversing a few boggy spots with tussocks of sedge, we found Mr. Carr's lower

On Kenya they range from this level to 14,500 feet or more.

We were now in relatively open country, with groves of trees, mainly the "kouso" (*Hagenia abyssinica*) but also a number of stately junipers (*Juniperus procera*) which suggest spruces by their form. Pines and spruces are wanting, but other plants allied to those of the temperate zone are the buttercups, alchemilla, red clovers, heaths, and large thistles, all conspicuous here. To my surprise there was also a light-blue *Scabiosa*, looking as though it might be a newcomer from Europe, and a white-flowered teasel (*Dipsacus*). A *Gladiolus* with unusually deep red blooms was a joy to behold, and there were purplish ground-orchids as well.

It is not easy to decide what to call a

rest-house. It was a sizable wooden building and had been carried up in sections. Along a stream that ran near it in a deep, narrow trench were a few tree-senecios, the first we noted; but close to the house were *Hagenia* trees and heaths.

Here were bunks and other camp furniture, an oil-stove that would burn the kerosene we had brought, comforts which though expected were still a surprise. Tents are good enough when unavoidable, but for comfort give me a hut, though its walls be of mud and its roof of grass.



BEFORE THE MORNING'S START

The carriers warm up beside the fire for their heavy day's work. Note the bamboo "alpenstocks"



LICHEN DRAPERIES

Trees at 8200 feet, where the first patches of small bamboos may be seen at the edge of the forest

Some old sacks of corn meal—they call it “mealie meal” in Kenya Colony—left by earlier visitors were a luxurious granary for a few bright-eyed dormice that scampered nightly about the hut.

Back on a hill above it we startled a lone klipspringer, a rock-loving antelope that one is always tempted to compare with the chamois. Here, too, Kamandu, our bird-skinner, found a pair of Jackson's francolins, partridge-like and nearly as large as chickens. Their loud, rasping calls have been compared to the whetting of a scythe.

Close to the hut came two kinds of sun-birds; the red-breasted *Cinnyris mediocris* and the large *Nectarinia tacaze*, a lustrous purple bird with two elongated tail-feathers. These are the characters of the males, their mates being dull and greenish. Old nests of *tacaze*, hanging pouches of lichen lined with feathers, could be found here and there on the tall bushes. Large starlings (*Onychognathus tenuirostris*) would perch awhile in high trees on

their way up and down the mountain. They seemed to “commute” between the lower mountain forest, where they could find fruit, and the rocks up near 14,000 feet where perhaps they sleep.

Other less conspicuous birds were brownish grass-warblers (*Cisticola hunteri*), cinnamon swamp-warblers (*Bradypterus cinnamomeus*), still another warbler with a rather broad bill and plumage washed with rusty (*Seicercus umbrovirens mackenzianus*), and a small brown flycatcher (*Alseonax minimus*). Flocks of white-eyes (*Zosterops virens somereni*), tiny yellowish birds with a conspicuous white ring of feathers around the eye, roamed through the boughs of the *Hagenias*. Of the finches we found *Serinus flavivertex*, best described as a dull-colored wild canary, and *Poliospiza striolata*, a streaky brown bird of much the same size and behavior as our American song sparrow. A black-capped waxbill (*Estrilda atricapilla kandti*) straggles up to this level, and at times a more typical weaver-

bird must come, too, for we were surprised to find four or five of its old empty nests on a tree at 10,000 feet. Likewise a black-and-white bush-shrike (*Laniarius ferrugineus ambiguus*) made its presence known with short, melodious calls.

To the birds of the deforested country about the base of Mount Kenya the forest zone must be a serious barrier, yet a certain number of them do wander up to the open alpine moors. One day we found a rufous-chested wryneck (*Jynx ruficollis*), on another occasion a couple of swallows flying by must have been *Riparia paludicola ducis*. The common red-tailed buzzard (*Buteo rufofuscus augur*), of the plains and savannas at 4000 to 7000 feet, is of regular occurrence in the alpine zone of Kenya. It can find abundant food by hunting the rodents that swarm there. By day one sees rats of the genus *Otomys* scurrying from tussock to tussock—they

look like giant meadow mice—and by night shorter-haired rats (*Lophuromys*) are abroad in numbers. The eagle owl (*Bubo capensis mackinderi*), which was discovered at 13,000 feet on Kenya, is likely to subsist on these same rodents.

The hyraxes living among the rocks would be rather large prey for the buzzards and owls; but they have their tryant, too, for the leopard leaves its tracks here and there in the soft earth. It must not be thought, from the mention of these few birds and small mammals, that they are all that exist about the 10,000-foot level, or that they are conspicuous. Often the landscape seems deserted, and particularly so during bad weather.

Here at least we had a roof over our heads, and an oil stove. How we would fare higher up the mountain was an open question.

TO BE CONCLUDED



ERNEST CARR'S "LOWER HUT"

DeWitt Sage leans against its hospitable wall, thinking perhaps of the energy required to place it so high on the misty mountain



"MESHIE"

FURTHER ADVENTURES OF MESHIE

A Chimpanzee That Has Lived Most of Her Life in a
New York Suburban Home

BY H. C. RAVEN

Associate Curator, Comparative and Human Anatomy, American Museum

The Columbia University-American Museum Expedition to Africa was sent out in May of 1929 under the leadership of Mr. Raven to collect specimens of adult gorillas and other African primates for anatomical study. Meshie was secured by Mr. Raven while he was on this expedition.—THE EDITORS

IN a former article in NATURAL HISTORY (March-April, 1932) I told how I obtained Meshie in the French Cameroun of West Africa, where we lived for a year before coming to America.

Meshie is now (July, 1933) four and one-half years old and weighs forty-six and one-half pounds. She still retains in good condition all her baby or deciduous teeth and, in addition, has her first permanent molars. The latter began to erupt when she was three years old, and all four were in place when she was three and one-half years. These first permanent molars correspond to the teeth often called six-year molars in human children.

In general appearance Meshie has not changed very much in the last two years,

though she has undoubtedly lost some of her baby looks and habits. When she was younger, she wanted to be picked up and held much of the time. Now, although she likes to embrace her human acquaintances occasionally, she is more independent and wants to walk and run about seeing things for herself, tirelessly investigating whatever she sees but easily tiring of any particular object. She walks with more poise and more assurance.

When she was very small, the hair on the sides of her head was long, like side whiskers, reaching below the level of her chin; now, this hair is comparatively short. Also the tuft of white hair so conspicuously standing out over



USING A STICK AS A TOOL

With her hand and foot she holds the stick and pulls the fruit within reach

the coccygeal region of the baby chimpanzee is no longer very noticeable. The skin of her hands, feet, and face, formerly of a uniform rich tan color, is now freckled with black, the black freckles becoming more numerous as time goes on. Anyone meeting Meshie now for the first time would be likely to think of her as a black-faced chimpanzee, for she has been outdoors day and night since spring and consequently her face and parts of her body where the hair is scant are sun-tanned so that they are very dark. A few months ago her face photographed white, but now it photographs black, due entirely to the effects of the sun.

In her mental development Meshie has changed more than in her appearance. She has learned many new things and can now keep an audience entertained for an hour or more, demonstrating to them how easy it is for a chimpanzee to acquire human accomplishments. One of these is her ability to free herself from

almost any bonds or confinement imposed upon her. She was never caged nor chained until we left Africa and began our long journey home. At first I fastened her with pieces of cord and rattan, but they were unsatisfactory, for she would get them tangled and then break loose by alternately pulling and biting the cord. Later, when I reached the coast, I procured a dog chain. This was better, but it was not long before Meshie discovered that it, too, could be broken if she pulled hard enough. This was especially easy if the links were tangled. She found many ways of gaining her freedom other than actually breaking the chain; for instance, there was always some sort of collar on her neck, at first merely a bit of rope with several knots in it. She discovered that she could always get the knots undone if she picked and pulled at them first with her fingers, and then, as they loosened, used her teeth also. Leather dog collars were easily

disposed of, for, if she found she could not undo the buckle, she pulled it to one side, wet the leather with her tongue until it stretched and broke, or could be slipped off over her head, or became long enough for her to get it into her mouth and bite it. Each time I left her tethered I wondered what new means she would find of freeing herself.

She has become quite expert at untying knots, so much so that it is one of her most admired accomplishments. As a demonstration I fasten a piece of woven cotton rope about her neck; three feet away I tie the rope around the leg of a chair and pull the knot very tight, finally leading the end of the rope off several feet out of her reach. Meshie immediately attacks the knot with her teeth and hands. As soon as one part of it is loosened she looks at it, decides the course she

must take, puts the loop over her head, and proceeds to crawl through it. If she is fastened with a "flat knot," she simply repeats this operation to free herself completely. She has many times freed herself from knots of this kind in less than thirty seconds. The most surprising thing is her apparent delight in doing it. After untying the rope, she coils it about her neck and walks off.

Long ago, when she was quite small, she took a fancy to untying shoe laces and later she learned to take off the shoe. Now, after removing one shoe, she holds it in her groin while she removes the other, then puts them on her own feet and walks about, much to the delight of her audience.

Sometimes she attempts to tie knots and several times she has succeeded, although her efforts are as yet extremely



WADING IN SALT WATER

Meshie pouring sand over Harry Raven's knee. She does not like to go into deep water and she cannot swim, but she likes to wade

crude from a human point of view. Nevertheless, they are just as effective as those of almost any small human child.

According to tests an adult female chimpanzee is approximately three and one-half times as strong as a college athlete. Meshie, about one-third grown, is about as strong as a grown man, though to see her slender arms and gentle ways one would be apt to underestimate her strength. My friends sometimes ask what Meshie would do if she got loose when I were not there. There were three such occasions last year. The first time she freed herself by breaking her chain, the second by packing her padlock full of sand and opening it, and the third time by a still more ingenious method. The first time she had been gone for about ten or fifteen minutes before her absence was discovered. She had climbed into some near-by wild cherry trees, where she spent her time in eating the fruit and young leaves. When Mrs. Raven discovered her, she had been free long enough to begin to feel a little uneasy, and when she was called, she came very willingly and allowed herself to be chained.

The second time she was discovered by some neighbors after she had wandered about fifty or seventy-five yards. She would not allow them to take hold of the chain that was fastened about her neck, and finally Mrs. Raven carried her home. Then the question arose as to

how to fasten her. The hardware dealer could not send a padlock immediately, so Meshie was loose in the house in the meantime. Some luncheon dishes had to be washed and Meshie insisted on help-

ing by sitting on the side of the sink and playing with the dish-cloth but being careful enough not to break anything. After this Mrs. Raven tried to sit quietly on a couch and read, but Meshie came over to her, sat beside her for a few moments, then began to bounce up and down as children like to do on a bed. She alternated this with standing on the head of the couch and jumping down into the middle of it.

Finally a man arrived with the padlock, and Meshie,

upon receiving some choice food, submitted to being chained.

The third occasion on which Meshie gained her freedom was a more complex and melodramatic affair. During the winter she was confined in a large cage in the basement. This cage was of wood and like a small room; it had been carefully constructed so that it offered very little opportunity for pulling apart from within. It was near a window and afforded her an opportunity to watch whatever was going on outside. I soon discovered that the cage had to be braced in every direction, for Meshie liked to climb up on the side and shake it with all her might, both for exercise and to hear it rattle. It was four feet square inside and had a hoop



BATHING

Some chimpanzees may be afraid of water but Meshie has a cement pool, where on hot summer days she plays in the water most of the time

fastened to the ceiling by a swivel, so that she could swing or rock on it or spin around, just as she pleased. That she might be kept perfectly clean, the floor of the cage was not solid but made of slats like the sides, so that no dirt or moisture remained on the floor. Sitting on the slats was just as comfortable as sitting on the branches of trees in her native tropical forest. Beneath this floor of slats was a funnel draining into a pan that could easily be kept clean. At night a blanket was given to Meshie to sleep on and, if the weather was cold, she completely covered herself with it. In the morning she pushed it out between the slats of her cage. Hay or straw was never given to her, as is so often the custom in zoölogical gardens, for chimpanzees in the wild live in comparatively dust-free tropical forests and the dust of the hay is not good for them.

Soon after being settled in her cage Meshie found that she could reach the electric light wires that were fastened to the basement ceiling. She pulled on these until it was no longer safe to leave them within her reach and we had an electrician remove them to the other side of the basement. One day for amuse-

pulled down several tins and bottles, the contents of which spilled on the stairs and floor. I continued to strengthen the cage and to move things out of her reach until at last I felt sure that she could get into no more mischief.

One day I received an anxious telephone message from Mrs. Raven, telling me that Meshie had been out of her cage for some time and that I had better come home. I asked, "Why did you not telephone immediately?" She replied that before Meshie had made her exit from the cage she had been flipping the burlap about and had caught the telephone wire on it and pulled out about six feet of the wire. It had been necessary for Mrs. Raven to repair the wire before any tele-

phoning could be done. She was alone in the house at the time and she locked the doors to prevent anyone from coming in or Meshie from going out. Meshie signified her pleasure at being free by embracing Mrs. Raven and saying "Uh-uh-uh!" repeatedly. Before coming upstairs she had had a look about the basement, playing for some time in the coal bin. After greeting Mrs. Raven, she went upstairs to the bathroom, and the coal dust in combination with a little water made black tracks all over the floor. From the bathroom she went into my little daughter's bedroom, leaving black tracks everywhere as she jumped up and down on the bed.



SOAP SUDS

She likes to have a rag and some soap to wash with and to make lather and suds, just as human children do

ment she began to flip a burlap bag at a shelf out of arm's reach above her head and beside the stairs. Perhaps by accident she first flipped the burlap over the shelf, but she repeated it until she had

nation with a little water made black tracks all over the floor. From the bathroom she went into my little daughter's bedroom, leaving black tracks everywhere as she jumped up and down on the bed.



WALKING IN THE SNOW

Chimpanzees have a coat of hair but no fur beneath it to protect them from severe cold, so, when Meshie goes out to play in very cold weather, she wears a sweater and galoshes

By that time Mrs. Raven had found her padlock and chain. When it was held up she came obediently to have it fastened around her neck, but she was unwilling to allow Mrs. Raven to chain her to a post in the basement, and immediately did everything in her power to get free again. The chain was loose about the post, so Meshie worked it up as she climbed until she was within reach of the electric light wires, on which she began to swing. Then, reaching with her hind feet, which are like hands, she grasped the gas-meter and pulled on it so hard that when I returned home I found the pipes bent and the meter standing out about a foot from the wall. A little more and a leak might have sprung, —only a few feet from the furnace!

When I arrived on the scene and asked sternly, "What have you done?" she

pouted, her lips stuck far out, and she put out her arms to embrace me; when I refused to take her and continued to scold, she screamed as if she were being terribly abused.

After the excitement had quieted down and order had been restored to the household, I asked how Meshie had broken out of her cage in the beginning. I found that she had done it by lying in her hoop, swinging and kicking the roof of the cage until she succeeded in raising one of the boards high enough for her to crawl through the opening made.

When Meshie first arrived from Africa, our children carried her on the handlebars of their tricycles as they rode about the yard. She seemed to enjoy this and often ran up to a tricycle, mounted it, and turned the handles from side to side as she sat with her feet on the saddle.

Her legs were so short that her feet could not reach the pedals. Later I bought Meshie a kiddie-car with pedals well adapted to her, but even then, when she first got on it she sat with her legs flexed and her feet drawn up. I took hold of her feet and pulled them down to the pedals, which she grasped just as she does the handles with her hands. It was not easy for her to understand how to push with her feet; she would forget about holding the pedals and would draw her feet up to the seat. To overcome this I finally fastened her feet to the pedals with strips of cheesecloth. If I did not watch closely, she would immediately reach down with her long arms and untie the cheesecloth, but if I spoke to her she would let it alone. It took only a short time for her to learn to push the pedals, but sometimes she made a mistake and pushed the wrong way, so that the machine ran backward. When she was

seated in the proper position, I held a peach or grape or other food she considered choice before her, calling her to come to me and reprimanding her if she attempted to dismount. At first I gave her the reward when she succeeded in propelling the kiddie-car only a few feet, but I increased the distance as she became more proficient. It was clear after a very few lessons that she understood how to hold the pedals, and the cheesecloth fastenings were no longer necessary.

Thus far, I had always stood directly before her. When I stood somewhat to one side, she pedalled right past me, for her hands on the handle-bars remained passive. When she passed in this manner she grew very much excited, stuck out her lips, and talked at a great rate. Then I pushed her arm to turn the machine. A few more lessons and she had learned to steer. When she ran into the wall or a chair, she reached out with her



SLEDDING

Meshie thoroughly enjoys sitting on the sled and being pulled; she also enjoys having her turn at pulling it

foot and pushed herself away, turned the handles, and went forward again, repeating this until she cleared the obstacle. Soon she learned that when the machine was in a corner or between objects where she could not turn it, or when the wheels were caught on the edge of a rug, she must dismount and pull it free. It was very comical to see her quickly dismount, impatiently jerk her kiddie-car clear of the obstacle, then mount and hurry on.

After several lessons indoors I took her out on the sidewalk. There she at first ran into the fence that bounded the walk on one side, or rode off the curb on the other side. Some of my friends thought I was cruel to let her ride off the edge and take a tumble, then make her pick up the car and pull it back on the sidewalk only to repeat the performance within a few seconds, but it soon taught her to keep away from both the fence and the curb. Sometimes our small children

and their friends had a parade, each one on some sort of tricycle or bicycle, with Meshie as the leader. She seemed to enjoy it as much as any of them.

Frequently during the past two years Meshie has been a visitor at the American Museum of Natural History. I drive in from the country with Meshie sitting beside me on the front seat of the automobile and at such times her behavior is just about perfect. She is keenly interested in the scenery and all that goes on along the way. When we stop at traffic lights, people in near-by cars often speak to her or laugh at her. Depending upon how she feels at the time, she ignores them or reaches out her hand in greeting. On several occasions when she has been spoken to by strangers, I have seen her reach for the handle and wind the window shut, or if it were shut, open it; in either case greatly amusing those watching her. Most of them seem



SUCKING GRAPE-JUICE THROUGH A STRAW

On this occasion, when Meshie had finished what was in her glass, she climbed up on her chair and finished the rest in the pitcher



AN ICE CREAM PARTY

Meshie considers ice cream a great treat and acknowledges it vociferously before being served and while she eats

to think it remarkable to see a chimpanzee entirely free, riding in a car like a human being.

When Meshie comes to the Museum I always bring her kiddie-car and she mounts it as soon as she leaves the automobile. Sometimes she rides through the long passageways in the basement. There the floor is of cement, but in some places where pipes cross beneath the passage they are covered by an iron plate. Although the iron is on the same level as the rest of the floor, Meshie stops, dismounts, and lifts her car over it. She seems to feel that this is necessary; why, I do not know. It may have been because sometimes the iron plates were hot. Another peculiarity like this was noticed when she was riding through one of the halls in the Museum where the floor was tiled in red with a border of black. When Meshie reached the black border at the end of the hall, she dismounted and

lifted her car over, just as she did when she came to the iron plates in the basement. When entering or leaving the elevator, she usually dismounts and carries her car in the same manner and often stops to peep down the crack between the elevator and the floor.

A short time ago I took Meshie into a new part of the Museum not yet open to the public. I pushed the button to call the elevator, then walked off about twenty feet to look into one of the halls in course of preparation. Meshie had seen me press the button, so she rode her kiddie-car over to it, stood up on the seat, and with her finger alternately and almost continuously pushed the up and the down buttons. As the elevator approached, I heard an outburst from the elevator man: "All right, all right! I'm coming; you don't have to keep on ringing!" Then he opened the door, saw Meshie still standing by the push-



PLAYING THE HOSE

When the hose is put on the ground within her reach she grasps it with one of her hind feet, then climbs up to her house, where she sits and sprays the water all about, sometimes even into the second-story windows. She drinks from the hose, claps one hand over the nozzle to make the water spray out sidewise, and alternately screws the nozzle right and left to turn the water on and off

buttons, blushed and said sheepishly: "I thought it was the Irishman that is working on the second floor."

Meshie frequently has luncheon with me in the Museum restaurant. She knows her way as soon as she leaves the elevator, driving her kiddie-car more rapidly as she approaches the room and begins to anticipate her luncheon. As she enters the restaurant she turns to me and says, "Mm-mm-mm!" If she is very hungry and becomes excited by the people, the clatter of dishes, and the smell of food, she gives shouts or screams of joy such as only a chimpanzee can give and loud enough to be heard in the open for half a mile or more. These screams always delight her human friends and seldom fail to startle those who hear them for the first time.

After that, she proceeds to the curators' table, unless I designate some other, climbs up into the high-chair ready for her, and places the folding tray in position. It hangs at the back of the chair and Meshie raises it up over her head and brings it down before her. Then she wants her dinner at once. She looks around for the waitress, puts her hand out toward her, and when she sees her dinner coming, rocks her body gently from side to side, saying "Uh-uh-uh!" When the food is before her, she picks up a spoon or a fork and begins to eat, not attempting to use her fingers as she used to do. If she happens to pick up the spoon with her left hand she soon transfers it to her right, not directly but by leaving it in her mouth, letting go with the left hand and then taking

hold of it with her right hand.

Meshie's regular diet consists mostly of plain wholesome food, such as bread and butter, milk, potatoes, spinach, green beans, lettuce, tomatoes and various fruits, with occasionally a little meat; in other words, Meshie eats whatever we have. Sweet things she considers a treat, consequently at the Museum I give her more sweets than usual. She may have two desserts,—caramel custard and ice cream, the latter being her favorite dish. When she has finished eating, she unfolds her napkin, wipes her face with it, and if not told to put it down, she will cover her head with it again and again as if she were playing blind-man's buff.

Not long ago Meshie had the honor of being a guest of President F. Trubee Davison of the American Museum of

Natural History at a formal banquet at the Waldorf-Astoria. What could be stranger, more unlike her former home in the African forest, than the ride across Manhattan in a taxicab, the brightly lighted hotel with gaily-dressed people everywhere, the brass band and negro minstrels! But she rode her kiddie-car through the foyer, into the banquet hall crowded with strangers, and took her place at the table with the rest of the guests. She politely ate some of each course as the dinner was served, sat quietly while the speeches were made, blinked while the Press photographers took more than a dozen flash-light photographs of her, and did not get home to bed until long after midnight. Not many chimpanzees have had such experiences. Not many children would have behaved as well.



ON PARADE

Meshie leads the parade, but, if the children stop or do not follow closely, she looks back inquiringly. When they keep close, she rides steadily along



The Temple of the Warriors. Reconstructed by Prof. K. Conant. After Morris

HIDDEN HISTORY

How a Little-Known Corner of Chichen Itza Adds a Page to the
Story of Pre-Columbian Yucatan

By GEORGE C. VAILLANT

Associate Curator of Mexican Archaeology, American Museum

CHICHEN ITZA in Yucatan is one of the most striking and best-preserved monuments of aboriginal civilization in the New World. It is of special interest because two cultures are seen in conflict, the Mayan and the south-eastern Mexican.

For ten years the Mexican Government and the Carnegie Institution of Washington have coöperated in the excavation and repair of these monuments. Numerous descriptions of Chichen Itza have appeared in current periodicals; longer accounts have been written by such scholars as Stephens, Maudslay, Maler, Holmes, Selser, Spinden, E. H. Thompson, J. E. Thompson, Marquina, Willard, Mr. and Mrs. Morris, and last but not least, Sylvanus G. Morley, under whose leadership the Carnegie Institution began its work at Chichen Itza. In 1926 it was my privilege to be on the staff of the Carnegie Institution and to make a small excavation there that shows

the utility of archæology as an historical method.

The chief American authorities on Mayan history, Morley, Spinden, and Tozzer, divide it into two great epochs, the "Old Empire" from the beginning of the Christian era to 630 A.D. and the "New," from 630 A.D. to the final pacification of Yucatan by the Spaniards in 1541. During the Old Empire the Maya perfected the magnificent civilization they had earlier evolved. They built great cities in the lowlands of Guatemala and invented a peculiar calendar system as accurate as our own. Possibly owing to the desiccation of their homeland, the Maya civilization gradually collapsed, and after 630 the Mayas ceased to record their dates in the accurate Old Empire style. The center of population then seems to have gradually shifted into Yucatan, where about 800 A.D. the Maya entered into a tremendous renaissance, chiefly architectural in its expression.

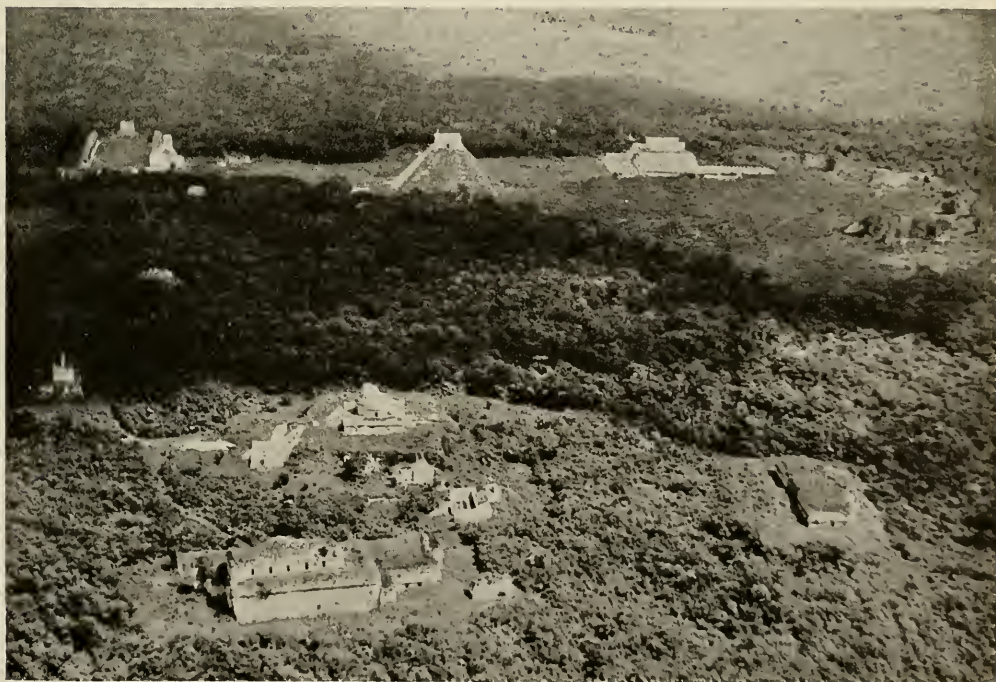
Although records were kept according to a briefer and less accurate method than in the Old Empire, the main events can be traced in their broader outlines.

During the second blooming, the Maya founded great ceremonial centers like Chichen Itza, Uxmal, Labna, and Mayapan. They flourished mightily until at the close of the Twelfth Century a civil war broke out among some of the greater chieftains, one of whom invited in some Mexican allies. As a reward for their services the Mexicans were given Chichen Itza, where, combining their own culture with the Maya civilization, they developed a specialized architecture and ceremonial art of their own, as rich as anything produced by their predecessors. About the middle of the Fifteenth Century, they were driven out by the Mayas, and, by the time of the Conquest, Chichen Itza had lost all its former prestige.

Now, at Chichen Itza there are three

main groups of buildings. The Castillo, the Ball Court, the Caracol, the Temple of the Warriors, are kindred structures which, from their architecture and sculpture, are assignable to the Mexican occupation. Another group of buildings, comprising principally the Nunnery, the Church, the Red House, and the House of the Dark Writing, are so similar to the definitely Mayan architecture at Uxmal, that there can be no doubt that they were the product of the Maya renaissance. Finally, to the south of these groups, are small clusters of buildings, some assignable to one or another of these architectural orders, but one apparently earlier group produced a lintel with an Old Empire date, causing archæologists to give the name Old Chichen to this quarter of the city.

Doctor Morley assigned me to analyze this group and find out what other evidence besides this lintel existed of an occu-



AIR VIEW OF CHICHEN ITZA

At the top of the picture may be seen structures of the Mexican period, at the bottom chiefly Maya buildings. Photograph by Colonel Lindbergh. From *The Temple of the Warriors*, by Morris



VIEW OF THE INITIAL SERIES GROUP

Looking southeast from Building III, after clearing and burning the bush. Remnants of the forest cover the Temple of the Phalli in the background

the small human altar supports, from the square columns adorned by engraved figures which support the roofs of so many Mexican buildings at Chichen. Thus there is some ground for belief that this edifice was constructed late in Mexican times and that its violation took place during the re-conquest of Chichen by the Mayas.

Our next step was to attack the Temple of the Initial Series, a badly battered mound surmounted by a ruined temple built of re-used stones filched from other buildings. On either side of the door stood two massive human figures each built of five superimposed blocks of stone. Across these rested the famous lintel, with its Old Empire date. At the foot of the slumped staircase stood a badly battered recumbent figure of the type called Chacmool.

The human figures appeared out of proportion, and the keen eyes of Juan Olalde, the *mayordomo*, discovered that two stone drums at the base of the pyramid, when fitted into their proper places

as the chest section of each statue, restored them to their true proportions. This situation suggested that the lintel had been placed in its present position *after* the destruction of the Temple. Doctor Morley questioned the *mayordomo* closely and elicited the information that years ago, when Mr. Edward H. Thompson, a pioneer in Yucatan archæology, had owned the hacienda of Chichen Itza, and Juan Olalde had worked for him, they had found the lintel on the top of the mound. They had set up the fallen figures, except for the missing drums, and crowned them with the lintel to preserve, and, as it were, to honor it. Therefore we had no grounds for assuming that the ruined temple was of the same date as the lintel and, indeed, the massive Atlantean figures, according to our hypothesis explaining the history of the Temple of the Little Heads, were a development of the latter part of the Mexican occupation, several hundred years later.

We examined the substructure with care and were struck by the fact that it



THE CASTILLO

One of the most imposing buildings of the Mexican period. Archaeologists of the Mexican Government, engaged in restoring this temple, found an earlier structure and a ceremonial cache buried under the platform. Photograph by the Department of Historical Monuments

was much larger than would be necessary to hold so small a building. On clearing away the refuse, we found that this platform was built of fresh cut stone, and the re-used stones were associated only with the little temple. Scattered in the débris on top of the platform were fragments of bowls and incensarios of a type found only at the surface of the ground in various parts of Chichen, and different from the fragments found within the Mexican period buildings. Since the incense burners of the modern Lacandonos or wild Maya are degenerations of this style, it is logical to conclude that these utensils are Mayan rather than Mexican and belong to the period of Maya re-occupation. These data corroborated the evidence of war and conquest produced by the intentional destruction of the altar in the Temple of the Little Heads.

The mystery of the large platform remained to be cleared up. We removed some of the outer facing near the stair, and after clearing away some rubble hearting, disclosed the side of a buried temple, its outer face severe and undecorated. The platform on which it rested was merely sheathed by the facing stones of the platform we had just discovered.

Heartening ourselves with the thought that just as every night is followed by a dawning, so every temple must have its door, we trenched behind the outer stairway until we found it, a broad central aperture separated by square pilasters from smaller openings at either side. In front of this wider portal lay the squat bulk of a sacrificial altar, over which priests were wont to stretch their victim before tearing out his heart.

A narrow vestibule, forty inches wide,

lay between the door and the temple, extending the width of the building. A smaller door gave entrance to a room 17 feet wide and 13 feet deep, having a low dais extending round its three solid sides. This building showed several rather peculiar features. The walls were too thin to support the heavy masonry of a vault wide enough to cover the room, so that there must have been a thatched or flat roof. A few re-used stones were utilized in the construction. Finally, the whole room was filled up with bowlders set in alternate blocks of raw and plastered masonry. Outside the temple, rubble was piled until the structure had been converted into a sizeable platform, when a stair and facing stones were added.

It seems clear from this evidence that the Mexicans had found the earlier temple unworthy of their gods, and had decided to build a nobler structure. By filling in the original building and re-

moving its roof, they created a substantial foundation for a far more pretentious temple than the meager structure of re-used stones where the dated lintel was found. Also the large Atlantean figures may well have been intended for this projected shrine. However, the reconquest of Chichen by the Mayas, which would abruptly halt further Mexican building activity, may well explain why the temple was never completed. Later on, perhaps, the Mayas, too broken by war to afford great structures as thank offerings to their gods, built the little shrine housing the Initial Series Lintel, dragged hither, perhaps as an heirloom from some earlier home, and at this place they made their offerings.

South of the Temple of the Initial Series lay the hulking mass of the Temple of the Phalli. The prying fingers of the tree roots had wedged off the façade, but the inner rooms were intact, save where



EAST WING OF THE NUNNERY AND THE CHURCH

Compare the lavish ornament of these Maya buildings with the simplicity of the Mexican period temple on the opposite page. Photograph by the Department of Historical Monuments



RECONSTRUCTING ATLANTIC COLUMNS (I)

Here Dr. Sylvanus G. Morley is fitting together fragments of the fire-shattered drums

columns suggest that an even earlier addition contemporaneous with the Castillo had been made.

Next they ran an ell south from the west side of the Main Temple, which was in the form of a massive, multi-chambered building, adorned by masked pan-

wooden lintels had rotted out. The long ranges of parallel rooms, the vestiges of a second story, and the thick walls suggested a building of the Maya New Empire, but a trench dug into the foundations of the building produced a few potsherds like those associate with Mexican period buildings. We discovered the edges of the low platform on which it rested and noted that the Temples of the Little Heads and the Initial Series were erected on an addition to this foundation. Possibly this building dated from the beginning of the Mexican occupation, when one would expect Maya methods of building still to be in the ascendant.

Behind the temple lay a perfect maze of rooms that showed a constant tinkering on the part of the Mexican architects with the plan of the structure. First, along the south side of the building, they erected a colonnade with square pilasters, carved with ceremonial figures, which supported a vaulted room. On the outer face of the roof ran a frieze of Eagle Knights. The style of this carving, according to M. Jean Charlot, was the same as that of the northwest colonnade of the Temple of the Warriors, the sixth construction in that complex monument. Vague traces of a colonnade with round

els, and a frieze of armadillos and turtles, and having the angularity of each corner softened by an engaged column. This building has no precise parallel at Chichen Itza.

Then, either because they needed more



RECONSTRUCTING ATLANTIC COLUMNS (II)

Hoisting the drums into place. Note the costume of the Maya workmen in this picture

RECONSTRUCTING ATLANTEAN COLUMNS (III)

The completed reconstruction of the figures from the temple south of the Phalli group

space or because the L shape of the building seemed asymmetrical, the Mexicans decided to make a patio by building two more ranges of rooms enclosing the space within the rectangle formed by the Temple of the Phalli, and its addition, the House of the Turtles.

To do this meant the covering up of much of the colonnade. But apparently anxious to conserve the pilasters carved so laboriously, they removed enough of them to extend the colonnade around the east and south sides of the patio. Laborious



and useless as this reconstruction would seem to us, it is very characteristic of the Indian mentality, for in almost every site in Yucatan similar cases may be found of uneconomical and intellectually awkward architectural practices.

On the outside of this latest addition in an inconspicuous position near the southwest corner, two large Atlantean figures were set as columns in the doorway of a minor chapel. There was no attempt to dramatize these figures, as seems to have been the intention of the builders of the Temple of the Initial Series. They were set aside in a corner of an unimportant addition to a major building.

The discovery of these figures showed the contemporaneity of the patio additions with the later substructure of the Temple of the Initial Series. Signs of plunder corroborated our historical reconstruction of the fate of the Temple of the Little Heads. Shell ornaments, knives, spindle whorls, chile graters, vases of every description lay scattered about the inner colonnade. Pieces of the same vases were found at opposite sides of the court. These surviving remnants of the personal equipment of the temple staff showed even more dramatically than previously, how sudden the onslaught and how complete the pillage.



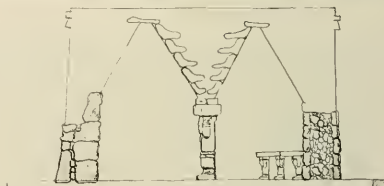
NORTHERN DOORWAY, TEMPLE OF THE PHALLI

Note how, before any structure was reared, the ground was levelled by elaborate terracing



COLUMNS AND ALTAR OF THE TEMPLE OF
THE LITTLE HEADS

Showing how the altar has been dismantled and the figures scattered. (Right) A reconstruction of the temple, showing how the false arches rested on the two large figures, and the original position of the altar



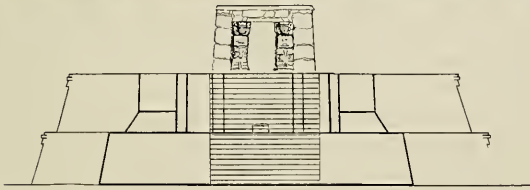
A few incensario fragments in the doorway of the Temple of the Phalli gave evidence that here, too, the Maya made offerings in late times. The razing of the southern and western rooms about the patio may have been done by these invaders, or, less dramatically, may have been the work of a farmer in historic times. In Yucatan the bush soon consumed the works of its adversary, man, and the climate accelerates decay and ruin.

The season drew to a close and funds ran low. The workmen were recalled to the Temple of the Warriors, where the need was pressing, so that it was impossible to investigate the other mounds in the group, or probe the involved construction of the House of the Turtles. The time had come to cast up our ac-

counts, however incomplete our record.

Two of the findings stood out. First, the Old Empire lintel was associated with one of the latest buildings in the group, and there was no structure examined by us which could have been its original source. Second, we were able to distinguish the pottery of late Maya re-occupation from that of the Mexicans, which, moreover, showed distinct affiliations with the ceramics of Central Vera Cruz and the Isla de Sacrificios. There was no close connection with the Valley of Mexico, such as one would expect were these Mexicans really Toltecs as is so often claimed.

The magnificently barbaric head of Tlaloc was the only artistically outstanding piece of sculpture encountered, but the use of Atlantean figures to support



THE TEMPLE OF THE INITIAL SERIES

A glance at the cut at the left will show the succession of buildings. The earliest temple, in heavy line, is partly disclosed in the photograph. See pages 621-623

the lintels of doors, and, in the case of the Temple of the Little Heads, the roof vault, was unique at Chichen Itza. The evidence of phallic worship was also extremely rare, Uxmal being the only other principal place of occurrence in the Maya area.

However, from the historical point of view the most significant data were obtained. There seem to have been four main periods. During the first we see the construction of the Temple of the Phalli, wherein the Mexicans seem to have followed quite closely Maya methods of plan and construction. In the second period we find connections with the superb developments in a new and typical style at the north of the city. The impulses that caused the rearing of the Castillo and the Temple of the Chacmool and the Ball Court are reflected in

the Colonnade south of the Temple of the Phalli, the Temple of the Owls, the Temple of the Little Heads, and the subtemple of the Initial Series.

In the third period, there is evidence of great building activity, but nothing is seen of the lavish ornamentation found in the Mexican temples at the north of the city. The patio south of the Temple of the Phalli was formed, construction was begun on the platform of the Temple of the Initial Series, and the precinct may have been enlarged. One is tempted to draw an analogy with the Carnegie Institution's work at the Temple of the Warriors. Even as the principal archaeologists and main body of workmen were concentrated on that building, while an assistant with a few men worked at Old Chichen, so in ancient times the leading

artists and artisans were utilized at the Temple of the Warriors and other buildings of the northern ceremonial center, while minor people with less skill tried to imitate that magnificence in the lesser temple group.

This period seems to have ended in a revolt against the Mexicans on the part of the neighboring Maya, perhaps because of the demands made on them by the Mexicans to get labor and material for the glorification of their gods. Where the battle was, we do not know, but in Old Chichen we found the residue from their plundering. Curiously enough, no trace of rapine was found in the Temple of the Warriors, but it is perfectly logical that the furnishings of the greater temple should have been conserved, while outlying shrines were left to their fate.

Finally, we witness the fourth period, represented by a few debased buildings like the miserable Temple of the Initial Series and by offerings found in earlier structures which the Maya continued to use. Presumably their resources were too depleted by war to keep up the great state of the Maya renaissance and the

Mexican occupation. When the Spaniards came to Chichen, they reported no state of culture comparable to the past splendor of the city.

The rich ceremonial architecture of Chichen Itza resulted from the fusion of two artistic and ceremonial traditions,

those of the Mayas and the southern Mexicans. Its excavation and elucidation is likewise due to a combination of two national strains, Mexico and the United States. The Department of Historical Monuments of the Mexican Government has declared the site a national monument and carries on important work in uncovering and preserving the monuments. The Carnegie Institution uses Chichen as the chief center for its survey of the Maya civilization



LIMESTONE HEAD, REPRESENTING THE MEXICAN RAIN GOD, TLALOC. FOUND IN THE WRECKAGE OF THE TEMPLE OF THE LITTLE HEADS

and the environment which first nurtured and then destroyed it. War between Mexicans and Mayas brought about the cultural efflorescence at Chichen Itza and war later left the site a yawning ruin. Today, in peaceful coöperation, the students of two countries are restoring these ancient wonders and rendering them accessible to the modern world.



BOWLS FROM THE ISLA DE SACRIFICIOS, VERA CRUZ, FOUND IN THE PATIO SOUTH OF THE TEMPLE OF THE PHALLI



A BIRD WITH A POWDER PUFF

A Toilet Outfit in Nature, Illustrating One of the Uses of the "Powder Down"
Patches in the Heron Family

BY LORD WILLIAM PERCY

FROM time immemorial the European bittern (*Botaurus stellaris*) has been associated with an atmosphere of legends and myths, and references to it in classical English literature have almost invariably some sinister allusion. Thus it appears in the Bible and in the works of English writers from Chaucer to Longfellow as an emblem of desolation and woe. Its booming love call in the mating season seems to have struck the human ear as something foreboding evil, and in truth, so unbirdlike are the resonant blasts of its horn, that it is small wonder our ancestors, even in comparatively recent times, were tempted into the superstitious belief that the bird had, in fact, a musical instrument of its own and produced the sounds by blowing down a hollow reed.

Such beliefs may appear fantastic to the modern student of natural history, yet fiction is hardly stranger than the literal truth, for, though the bird is devoid of any artificial aids for the creation of its music, it is liberally supplied

with certain other requisites of which the widest use is made today among so-called civilized mankind.

The possession by the herons of small localized patches of "powder down" on their bodies is well known, but if their use has ever been witnessed it has apparently never been reported, described, or illustrated until this year.

Some ingenious person not so long ago suggested that these patches were luminous and acted as a kind of jack-light for night fishing, but in fact herons are mainly day and not night fishers, and he who is prone to ridicule the ancients for the lack of knowledge that permitted other superstitious beliefs, must confess that no better basis existed for the modern hypothesis than for the older belief in a musical instrument.

These "powder puffs" by no means exhaust the toilet outfit with which the bittern is provided, for it also includes a cleansing powder or shampoo, a comb, and a reservoir of hair oil.

While it is dangerous in the study of



CLEAN AND SPOTLESS

When the parent returns from an expedition yielding other fish than eels, her plumage still retains its spotless condition

AFTER AN EEL HUNT

About ninety per cent of the diet of the baby bitterns consists of eels. Here the matted condition of the mother bird's feathers gives ample evidence of her encounters with the slimy prey





A HARD SCHOOLING

Should the clumsy youngster be too slow to pick up and swallow the food disgorged by his mother, she re-swallows it despite all his protests



AN EARLIER FEEDING STAGE

The young bird holds the parent's bill at right angles across the nostrils as its mother disgorges food into its gullet



THE GROOMING BEGINS

The bird repeatedly buries her head and neck beneath the flanks along the line of the powder puffs

nature to assert anything which is not fully supported by ascertained facts, it does not seem unduly rash to assume that, in the case of two birds so closely allied as the American "stake driver" and the European bittern, that which is applicable to the one is no less applicable to the other.

The observations here recorded were made at a nest in East Anglia in the spring of 1932, and after weeks of study and still photography, it seemed that the results were of sufficient interest to justify the attempt to illustrate the whole performance by means of a moving picture. Accordingly some days were devoted to this, and so completely accustomed had the bird become to the sounds of camera shutters that in spite of the fact that the moving picture camera was a particularly noisy machine, the only

traces of alarm shown were during the first five seconds after the handle of the machine was put in motion. During the whole of the performances hereafter described, not once did she betray the slightest indication that she was even aware of the existence of the camera



AFTER CONTACT WITH THE POWDER PUFFS
Every time the head emerges, powder and bits of powder down may be seen clinging to the bird's head or bill

seven feet from the nest.

In the case of this particular individual every article in the toilet outfit mentioned above was so constantly and regularly in use during the weeks when she was kept under observation, that to the spectator it seemed that the loss of them would constitute no mere passing inconvenience but the deprivation of a primary necessity upon which her very life depended.

At least ninety per cent of the diet with which she supplied her family con-

sisted of eels, and in the course of several weeks the only other food she was seen to disgorge was a few small fish such as roach or rudd. How does a bittern kill an eel? Here we are compelled to draw on imagination or at least deduction for an answer, for it is in the highest degree unlikely that in the dense reed-beds any human eye would be fortunate enough to witness the act in the natural course of events.

It seems at least probable that the method of procedure is similar to that

low its prey alive rather than leave it, but any human being who in imagination contemplates the sensations liable to be produced by a live eel in his stomach will sympathize with the bird which prefers his meal after its back has been thoroughly dislocated in several places.

This method of preparing it has however one disadvantage, for it is no less messy than the human method of killing and skinning it. The only difference is that in the case of the human it is the hands whereas in the case of the bird it is the head and neck that suffer, for with each shaking of the eel the swinging, loose end leaves its slime upon the feathers of its captor. Feathers allowed to remain in such a matted condition are a serious danger to their owner, for, unless their "free" and waterproof state can be quickly restored and maintained, they



THE SHAMPOO

The head and neck grow a shade whiter with every application of the self-supplied dry shampoo

adopted by the herons which, feeding in more open situations, are more easily observed. In their case the eel is speared, lifted out on to dry land, and there subjected to such poundings, pecks, and above all, shakings, as will reduce it to inertia. If disturbed, the bird may swal-



READY FOR THE COMB

After the cleansing powder has done its work, each foot is brushed alternately over the head and neck



THE SECOND STAGE OF THE GROOMING

The bird lifts her tail coverts, exposing the large oil gland beneath them

cease to perform their function and at once constitute a serious threat to health.

In an accompanying illustration the bittern is shown in the bedraggled condition in which she returns to the nest from an eel hunt. In fact, an eel has just been supplied to her eldest child, and the preoccupied expression of his countenance is no doubt due to the sensations caused by that ungainly swelling that can be seen in his neck.

If other evidence was required to corroborate the conclusion that the source of her matted plumage is eel-slime, it is supplied by the comparatively spotless condition in which she returns from an expedition which has yielded other fish than eels.

The process of education of the young in these feeding operations is most interesting, for it has at least the appearance of calculation. In the early stages completely digested food is disgorged directly into the gullet of the young bird as it

holds the parent's bill at right angles across the nostrils. At a later stage undigested food is disgorged in the same manner, and eventually as the training of the young is advanced the food is disgorged on the nest for the young to pick up for themselves. At this stage the schooling is a hard one for no great patience is shown with inefficiency, and if the youngster is clumsy about picking it up, he will be allowed no more than a few attempts before being punished by the sight of his mother re-swallowing the object herself in spite of all his protests. Thereafter he may have three or four hungry hours in which to ponder on better methods of picking up those slippery objects with which his mother supplies him before his ears are again gladdened by the sound of her approach as she stalks along the reed-stems on her next visit.

But to return to the toilet. The articles of which it consists have already been

THE OIL FONT

She agitates the oil gland by gently rubbing it along and between her mandibles



THE OIL RUB

Then she rubs the whole of her head and neck upon the oil gland, thus replenishing the natural oil of the plumage





THE FINAL SHAKE

She puts the finishing touches to her toilet by giving a last thorough shake to her plumage

enumerated, but it is necessary to locate them. A powder puff is situated in the region of each armpit, and another on each thigh, the cleansing powder is produced by these puffs, the comb is below the claw of the middle toe, and the hair oil in the gland above the base of the tail feathers.

Each will be called into play in its turn, for the routine is fixed and invariable, though the situation chosen for the performance will vary according to conditions. On a cold, wet day it may be performed while the parent stands or crouches above her shivering young, which indeed are rarely brooded at any other time, but in finer weather she may surprise the onlooker by climbing to the very summit of the reed-stems and, from that precarious situation, displaying not only the details of her toilet but a balancing feat which would surely command the admiration of a tight-rope walker.

The primary object of the elaborate

and painstaking toilet which is to occupy from one to one and one-half hours according to the extent of the damage to be repaired, is to dry off and disintegrate the eel-slime, and it is achieved by repeatedly burying the head and neck beneath the flanks along the line of the powder puffs.

After a few applications, as the head emerges, not only powder but pieces of powder down may be seen clinging to head or bill. Again and again as the action is repeated the bird appears headless and each time the head re-appears a shade whiter until at length from crown to nape the whole head and neck are covered with her self-supplied dry shampoo, her black cap now turned to the palest gray.

The first stage of the toilet has now been completed, and the interval that must be allowed for the powder to do its work can be utilized by adding fresh reed-stems to the nest or dozing with eyelids closed on the piercing yellow eyes.

whose forward and downward gaze in her waking moments give that strange impression of a squint.

In due course it is time for the comb to be brought into play, as first one foot and then the other is brushed over head and neck with a movement so rapid that the eye cannot determine whether the middle toe with its serrated claw is used to the exclusion of the rest. At all events the result is a more or less complete return to cleanliness, though not infrequently the whole of this preliminary performance has to be repeated, and on rare occasions even yet again.

Incidentally it would be interesting to know both the origin and the nature of this powder. Is it formed by disintegration of the powder down or is it a product of it? Has it any other than a mechanical action? The latter is obvious to the eye, but for the human being whose avocation necessitates frequent contamination by oily substances there are innumerable patent cleansers on the market. Is it possible that nature has provided the bittern with a similar chemical preparation?

In any case it is evident that so effective is the action of the cleanser that it assures the removal not only of the slime but also of the natural oil of the plumage, for otherwise the last and perhaps the most spectacular act of the toilet would be unnecessary. As she stands on the reeds or at the nest, her tail coverts are

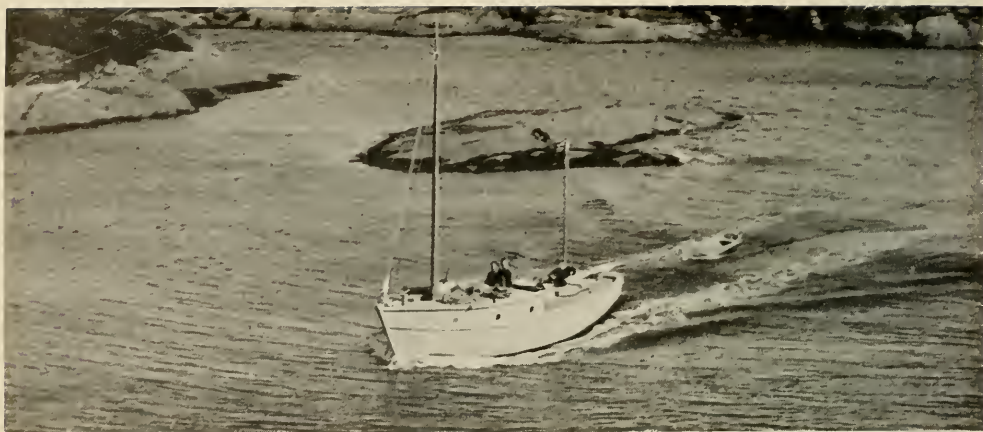
suddenly seen to rise, exposing the large oil gland beneath them, and for some minutes the bird will agitate it with her bill, gently rubbing it along and between her mandibles. In my experience neither from live or dead birds is it possible to extract oil from such a gland externally, though the small tuft or brush with which it is furnished may leave an oily sensation on the fingers. The action of the bittern seems to suggest the possibility that the gland requires excitement in order to make it secrete, for the final act of rubbing the whole of her head and neck upon it was invariably preceded by a period of agitation with her bill.

A final shake out as she ruffles all her plumage puts the finishing touches to her appearance, and the dishevelled apparition that arrived at the nest an hour or two ago has been transformed into an object as faultlessly attired, as immaculately groomed, as any lady of fashion.

Indeed there is nothing new under heaven. Before ever the first of our race set foot in the New World or the first beauty parlor was set in New York, Paris, or London, for how many thousands of years had the "stake driver" boomed his love-song and powdered his face in that elaborate toilet? At least we must grant him the precedence of a pioneer in the use of toilet requisites in days when the lords of creation were innocent of all knowledge of their uses—or abuses.



IMMACULATE AGAIN



The "Alca" along "The Labrador"

ALONG AUDUBON'S LABRADOR TRAIL

Bird Study Today and a Century Ago

By ALFRED M. BAILEY

The Chicago Academy of Sciences

PHOTOGRAPHS BY THE AUTHOR

ONE hundred years have passed since John James Audubon made his memorable cruise along the southern coast of Labrador in his little schooner "Ripley." He and his five companions sailed northward from Eastport, Maine, on June 6, 1833, and two days later were "dancing on the waters, all shockingly sea sick," in the Bay of Fundy. Their route took them past the Magdalene Islands, where they stopped to inspect the marvelous gannet colonies and to secure specimens for their collection.

On June 17 they arrived off the coast of Labrador, opposite the mouth of the Natashquan River "where the Hudson Bay Company has a station." They traveled a few miles to the westward and made their first headquarters in American Harbor, where they worked for many days. Audubon recorded in his journal,

And now we are positively on the Labrador coast, latitude 50° and a little more,—farther north than I ever was before. But what a country! When we landed and passed the beach, we

sank nearly to our knees in mosses of various sorts, producing as we moved through them a curious sensation. These mosses, which at a distance look like hard rocks, are, under foot, like a velvet cushion. We scrambled about and with anxiety stretched our necks and looked over the country far and near, but not a square foot of *earth* could we see. A poor, rugged, miserable country; the trees like so many mops of wiry composition, and the soil is not rocky, it is boggy to a man's waist.

Audubon and his party worked north-eastward along the coast, to the Straits of Belle Isle, stopping at five different harbors en route; they collected specimens of the animals and plants which they encountered, and the great naturalist spent many weary hours at his desk, making paintings of birds which illustrated his *Birds of America*.

It was my privilege this past season to follow Audubon's route, to visit many of the places he visited, and to record in motion film, for the Chicago Academy of Sciences, the life histories of many of the quaint birds which he first portrayed in oil. One hundred years is a

long time in the lives of men, although the rugged pre-Cambrian rocks of Labrador, among the oldest of our continent, probably show little evidence of the passage of a century. The coast region is being elevated at a rate of an inch a year, so the hills are a few feet higher than when Audubon climbed among them; motor-driven boats have displaced sailing vessels to a certain extent—but if Audubon could return to his old harbors he would find few changes. Transportation along the “north shore” is now a simple matter, however, for boats visit the ports at regular intervals. It is a five-day journey from Quebec to Harrington Harbor, one of the largest of the settlements along the coast, and we were off Natashquan, July 3,—“a country of low spruces, dogwood, and tundra-like expanses covered with moss.”

Two days later we ran before a wind blowing a half gale and dropped anchor in the well sheltered harbor in front of Harrington, where the services of a local fisherman, a Newfoundlander, Uncle Eli Anderson, were secured. When the storm abated, Uncle Eli piled my bulky photo-

graphic equipment into his fishing boat, and, with sail set, we headed across the gulf toward the St. Mary's bird sanctuary, which could be seen through the haze, twelve miles to the westward.

Enjoyable days were spent on those worn, moss-covered islands, for they were protected havens where the birds could carry on their household affairs without the interference of man. The Canadian government has established reservations along the whole southern part of Labrador peninsula—areas here and there which are best suited for the protection of bird life, and the St. Mary's group, protected by the keeper of the light, Fred Osborne, was the home of thousands of birds. There we found the red-throated loon nesting along the borders of small ponds, eider ducks by the hundreds under dwarfed, wind-blown spruces, black-backed and herring gulls upon the slopes of the moss-grown hills, and quaint sea birds of several species among the ice-worn bluffs rising from the sea. After days of Labrador weather—fog, rain, and brilliant sunshine, cold winds and delightful calms, Dr. Harrison Lewis,



OFF BLANC SABLON

The end of Audubon's route, now the easternmost settlement of Canadian Labrador

chief Federal migratory bird officer of that district, called for me in his new boat, the "Alca," that we might follow along Audubon's trail, visit the places he visited, and photograph the birds which he painted. Doctor Lewis has an intimate knowledge of the animal and plant life of the region; as a result of more than ten years of intensive study, he knows every island inhabited by numbers of birds, and I could not help thinking that if Audubon had had the association of some one with such a knowledge of Labrador wild life, he would have had a better time.

Let us drop our anchor in a sheltered bight among the islands which form the Fog Island Sanctuary,—a long day's journey to the westward of St. Mary's Island. On shore, dimly visible through the mist of fog, was a fisherman's cottage, known as the "Bluff," although there are no hills apparent. It was our hope to photograph some of the wonderful colonies of sea birds—when the on-shore wind subsided sufficiently to make a landing on islands in the open gulf. In the meantime we had to wait as patiently as we could for the change in wind which would bring better photographic conditions.

The wind fell during the night and the fog cleared away by 4:30, so we were soon headed across a choppy sea for the bird islands, where we expected to find colonies of murre, cormorants, Caspian terns, and

ring-billed gulls. And we were not disappointed. The larger island was inhabited by a myriad of the silver-winged gulls, and terns of three species. Even black ducks and green-winged teals flushed from the small tundra pool. A few hours were spent in the blind, particularly for photographs of the Caspian terns, as it is the only colony on that part of Labrador.

A half mile to the eastward we found one of the finest murre colonies encountered on the trip. Nearly two thousand birds were scattered over the ice-worn rocks, and by stalking them carefully, we were able to approach within a few feet and photograph them to our hearts' content. Downy young and large, speckled eggs of every color were scattered on the rocks, and the white-breasted adults were

shrieking and groaning their disapproval of our invasion, and yet, so strong was the urge to care for their young or eggs that they refused to leave. These birds have been greatly persecuted by the fishermen of the coast, for their eggs are excellent eating. Audubon protested bitterly against the thoughtlessness of man in robbing the birds and destroying the wild things about him but, in the years that followed, literally



A FEW COD

The fishermen of the Newfoundland Coast work hard wresting a living from the sea

thousands upon thousands of eggs were taken. It was not until the Canadian government began to protect the few remaining nesting colonies that any respite was given. Now, however, after some



THE LIGHT ON GREENLEY ISLAND

On this island the "Bremen" landed after its successful flight across the Atlantic

years of careful protection, the wild fowl have shown a decided increase, and we may be sure that the interesting sea birds will be safeguarded in the years to come.

A few hours' run to the eastward of Fog Island brings one to Cape Whittle, a prominent landmark of that region. From there the coast runs northeast to the Straits of Belle Isle. We rounded the cape, and the "Alca" pitched and tossed as we ran parallel to the red cliffs marked "Cormorant Rocks" on the chart. We made an excellent anchorage in a beautiful little fiord in Lake Island, just behind the cliffs. On June 29, 1833, Audubon visited the same spot. He records in his journal of that date:

As we advanced, we passed by a rock literally covered with cormorants, of what species I know not yet; their effluvia could be perceived more than a mile off. We made the fine anchorage where we now are, about four o'clock. We found some difficulty in entering on account of our pilot being an ignorant ass; *twice* did we see the rocks under our vessel. The appearance of the country around is quite different from that near American Harbor; nothing in view here as far as eye can reach, but bare, high, rugged rocks, grand indeed, but not a shrub a foot above the ground. The moss is shorter and more com-

pact, the flowers are fewer, and every plant more diminutive. No matter which way you glance, the prospect is cold and forbidding; deep banks of snow here and there, and yet I have found the Shore Lark (*Alauda alpestris*) in beautiful plumage. I found the nest of the Brown lark (*Anthus spinoletta*) with five eggs in it; the nest was planted at the foot of a rock, buried in dark mould, and beautifully made of fine grass, well and neatly worked in circularly, without any hair or other lining.

The European cormorant is an extremely rare bird in North America, and until the past few years, it was thought no breeding colonies existed. Audubon found both the European, or common, and the double-crested cormorants in numbers upon these Wapitigun cliffs, but the birds were practically exterminated by fishermen in the years that followed. A few persisted, however, and Doctor Lewis found a dozen pairs nesting when he undertook to protect the sea birds of Labrador. Now, the colonies are spreading, for in addition to ninety-seven nests counted on the cliffs, a small group has started building on the St. Mary's Sanctuary seventeen miles away. So, one more North American bird has been saved from extinction.

Audubon did not care for Labrador. His notes are filled with objections to weather conditions, but he had one day, at least, which he enjoyed. It was while anchored "in the noble harbor of Wapitigun." On July 2 he wrote,

A beautiful day for Labrador. Drew another *Mormon arcticus*. Went on shore and was most pleased with what I saw. The country, so wild and grand, is of itself enough to interest any one in its wonderful dreariness. Its mossy, gray-clothed rocks, heaped and thrown together as if by chance, in the most fantastical groups imaginable, huge masses hanging on minor ones as if about to roll themselves down from their doubtful situations, into the depths of the sea beneath. Bays without end, sprinkled with rocky islands of all shapes and sizes, where in every fissure a Guillemot, a Cormorant, or some other wild bird retreats to secure its eggs, and raise its young, or save itself from the hunter's pursuit. The peculiar cast of the sky, which never seems to be certain, butterflies flitting over snowbanks, probing beautiful dwarfed flowerets of many hues pushing their tender stems from the thick bed of moss which everywhere covers the granite rocks. Then the morasses, wherein you plunge up to your knees, or the walking over the stubborn, dwarfish shrubbery, making one think that as he goes he treads down the forests of Labrador. The unexpected Bunting, or perhaps Sylvia, which perchance, and indeed as if by chance alone, you now and then see flying before you, or hear singing from the creeping plants on the ground. The beautiful fresh-water lakes, on the rugged crests of greatly elevated islands, wherein the Red and Black-necked Divers swim as proudly as swans do in other latitudes, and where the fish appear to have been cast as strayed beings from the surplus food of the ocean. All—is wonderfully grand, wild—aye, and terrific.

And yet how beautiful it is now, when one sees the wild bee, moving from one flower to another in search of food which doubtless is as sweet to it as the essence of the magnolia is to those of favored Louisiana. The little Ring Plover rearing its delicate and tender young, the Eider Duck swimming man-of-war-like amid her floating brood, like the guardship of a most valuable convoy; the White-crowned Bunting's sonorous note reaching the ear ever and anon; the crowds of sea-birds in search of places wherein to repose or to feed—how beautiful is all of this in this wonderful rocky desert at this season, the beginning of July, as compared with the horrid blasts of winter which here predominate by the will of God, when every rock is rendered smooth with snows so deep that every step the traveller takes is as if entering into his grave; for even should he escape an avalanche, his eye dreads to search the horizon, for full well does he know that snow—snow—is all that can be seen. I watched the Ring Plover for some time; the parents were so intent on saving their young that they both lay on the rocks as if shot, quivering their wings and dragging their bodies as if quite disabled. We left them and their young to the care of their Creator. I would not have shot one of the old ones, or taken one of the young for any consideration, and I was glad my young men were as forbearing.

But on July 10 he entered in his journal,

Could I describe one of these dismal gales which blow ever and anon over this desolate country, it would in all probability be of interest to one unacquainted with the inclemency of the climate. Nowhere is the power of the northeast gale, which blows every week on the coast of Labrador,

so keenly felt as here. I cannot describe it; all I can say is that whilst we were in as fine and safe a harbor as could be wished for, and completely land-locked all around, so strong does the wind blow, and so great its influence



A SPOTTED SANDPIPER'S NEST

Where the birds carry on their household affairs without the interference of man

on our vessel, that her motion will not allow me to draw, and indeed once this day forced me to my berth, as well as some others of our party. One would imagine all the powers of Boreas had been put to work to give us a true idea of what his energies can produce, even in so snug a harbor. What is felt outside I cannot imagine, but greatly fear that few vessels could ride safely before these horrid blasts, that now and then seem strong enough to rend the very rocks asunder. The rain is driven in sheets which seem scarcely to fall on sea or land; I can hardly call it rain, it is rather a mass of water, so thick that all objects at any distance from us are lost to sight every three or four minutes, and the waters come up and beat about us in our rock-bound harbor as a newly caged bird does against its imprisoning walls. The Great Black-backed Gull alone is seen floating through the storm, screaming loudly and mournfully as it seeks its prey; not another bird is to be seen abroad; the Cormorants are all settled in the rocks close to us, the Guillemots are deep in the fissures; every Eider-Duck lies under the lee of some point, her brood snugly beneath her open wings, the Loon and the Diver have crawled among the rankest weeds, and are patiently waiting for a return of fair weather, the Grouse is quite hid under the creeping willow, the Great Gray Owl is perched on the southern declivity of some stupendous rock, and the gale continues as if it would never stop.

Audubon left the Wapitigun cliffs July 13 and stood out to sea, passing well offshore from the St. Mary's Islands, finally arriving at Little Mecatina Harbor the next day, after a voyage which they had not enjoyed, as "all were sea-sick as much as ever."

We pursued our leisurely way along

Audubon's route by following picturesque passageways where we could observe and stop to photograph, if we so desired. An exceptionally fine colony of ring-billed gulls has nested for years on a small

island off Pointe au Maurier, and offered an excellent opportunity to expose motion film. A bit of open gulf lies between the Pointe and Harrington Harbor, but an early start put us across before the wind stiffened.

The people of the coast are Newfoundlanders, for the most part—hard working, honest fisher folk who have their troubles wresting a living from the sea. It was the height of the codfishing sea-

son, but because of the inclemency of the weather, few of them had made wages, while many of them had lost their nets. The greater number depend upon hand lines to catch their cod, but it is a slow and difficult work at best.

It is only a short run by motor boat to Cross Harbor on Little Mecatina Island, although Audubon found the journey a miserable one on his sailing craft, owing to adverse weather conditions. The harbor is an excellent one, flanked with high, moss-covered hills down which tumbled streams of crystal clear water. Newfoundland schooners were anchored from the storm, boats and crew resembling those Audubon found there. The entrance to the harbor is extremely narrow, and it was there that Audubon observed



THE RED-THROATED LOON
Nesting along the borders of small ponds on an island in the St. Mary's group



A BABY MURRE

Photographed on an island in the Fog Island Sanctuary, where an exceptionally fine colony of murres exists today

that at particular stages of the tides the Eider Ducks entered and returned by it. By hiding ourselves on both sides of the channel, we succeeded in killing a good number, but rarely more than one at a shot, although sometimes we obtained from a single file as many as we had of gun barrels.

The "Ripley" was anchored in Hare Harbor, on the opposite side of the island on July 14, 1833. Audubon wrote,

Our harbor is the very representation of the bottom of a large bowl, in the center of which our vessel is now safely at anchor, surrounded by rocks fully a thousand feet high, and the wildest looking place I ever was in.

We headed the "Alca" in to Hare Harbor just ninety-nine years later, and found it a picturesque place indeed, with abrupt ice-worn walls, although Audubon's estimation of height was a little exaggerated. They probably rise two hundred and fifty feet above the sea. The far-reaching call of the ravens was heard echoing among the cliffs, black-backed gulls perched upon boulders of the moss-covered hills, and female eiders, with their broods of young, slid through the glasslike waters in the shadows at

the base of the towering rocks. It was not hard to turn the calendar back a century and visualize Audubon and his young men returning from their day's work afield, tired after the struggles through the yielding moss, but well satisfied with the results of their efforts. Little has changed in that remote spot.

Audubon remained in the harbor until July 21, and then started for the Straits of Belle Isle, stopping at Sparr Point, some hours away to visit at a sealing establishment. The descendants of his host, Mr. Robertson, still live at the Point, and a limited amount of sealing is still carried on.

Enchanting waterways lie en route, but Audubon, because of his "ass of a pilot," had to sail through the open sea to "Bras d'Or." We followed along narrow fiords which ran behind low, rounded hills—some typically alpine, and others Hudsonian with their growths of evergreens and alders. We heard gray-checked thrushes when we stopped our engine, and a few black flies came aboard to remind us what we might expect if

we cared to wander inland. The passageways loomed black as the sun dropped behind the hills—gulls sailed silently along on set wings, apparently headed for some particular resting place, and when we entered an open bay with a view to the westward, we found a lavender sea tinted with a sheen of gold and silver. It was the lonesome time of day when one could wax romantic, but Doctor Lewis broke my reverie by prophesying bad weather for the morrow. We followed along precipitous shores, passed Cumberland Harbor, which Cartier said was the finest harbor in the world, and then modestly added, "I called it 'Jacques Cartier Harbor!'" About thirty miles beyond was Old Fort, which is probably the oldest settlement in North America, as, so I was told, it was founded by the French fishermen ten or fifteen years after Columbus discovered America. The town of Brest, as it was then known, is mentioned many times in the Journals of the explorers of the St. Lawrence.

Audubon arrived at "Bras d'Or" July 26. He entered in his notes:

The coast we have followed is like that we have hitherto seen, crowded with islands of all sizes and forms, against which the raging waves break in a frightful manner.

After they were towed into the harbor, Audubon found a fleet of one hundred and fifty sail, principally fore-and-aft schooners, a few pickaxes, etc., mostly from Halifax and the eastern portion of the United States.

Fishing boats still drop their anchors in the same places of refuge and fishermen continue to take cod as they did in years gone by. The industry is not as extensive as in former times, however, for comparatively few boats are seen; even the great establishment on Greenley Island, where the "Bremen" landed after its successful flight across the Atlantic, is now of little importance.

Audubon found many things of interest in this vicinity. He always seemed to delight in meeting people—and after all, that is the most interesting part of any field trip—and his notes are filled with references to kindnesses extended him by fishermen and by the inhabitants of the village of Blanc Sablan,

now the easternmost settlement of Canadian Labrador. They visited Perroquet Island, where the Atlantic puffins, the drollest of sea fowl, nest abundantly. It is now a government sanctuary, one of the finest sea-bird colonies in North America, and Audubon's description, written one hundred years ago, is equally true today.



YOUNG AMERICAN EIDER DUCKS

Bird life is well protected by the Canadian Government along the whole southern part of Labrador peninsula

We have been to Paroket Island to procure the young of *Mormon arcticus*. As we approached these breeding places, the air was filled with these birds, and the water around absolutely covered with them, while on the rocks were thousands, like sentinels on the watch.

It is just a little place two hundred yards long, possibly, and every foot of it is undermined with the burrows of

these quaint creatures of the sea. Doctor Lewis and his helpers actually counted the burrows a few years ago, and obtained a result of 21,000, or an estimated population of 45,000 puffins. In addition, approximately 5,000 razor-billed auks dwell upon this unique island.

Audubon was so fortunate as to encounter migrating eskimo curlew, a species which has become dangerously near the line of extermination. On August 3 he recorded,

I have seen many hundreds this afternoon, and shot seven. They fly in compact bodics, with beautiful evolutions, overlooking a great extent of country ere they make a choice of a spot on which to alight.

Recent reports indicate that a few of these rare birds have been observed in northern Labrador, and I like to think, although the chances are slight, that among the curlews which I saw along the storm-swept shore of the Straits of Belle Isle, there might have been one or two of these wanderers,—brown shore birds of our north, which cross the

equator to spend the winter in Argentine and Patagonia.

The naturalist's work was concluded on August 10, for he sailed for the south the following day. He had not had a pleasant trip, as he had attempted more than he was physically able to accomplish; he pressed himself to the utmost, often drawing seventeen hours a day in a chilly, poorly ventilated cabin. He was worn out when his work was concluded, and in his journal we find the confession,

Yesternight, when I rose from my little seat to contemplate my work, and to judge the effect of it compared with the nature which I have been attempting to copy, it was the affair of a moment; and instead of waiting, as I always like to do, until that hazy darkness which is to me the best time to judge of the strength of light and shade, I went at once to rest, as if delivered from the heaviest task I ever performed. The young men think that my fatigue is added to by the fact that I often work in wet clothes, but I have done that all my life with no ill effects. No! No! it is that I am no longer young. But I thank God I did accomplish my task; my drawings are finished to the best of my ability.



PUFFINS



"'Possum"

PHOTOGRAPHING NATURE

The Infinite Variety of Subject Matter That Is Available to the Hunter
Who Uses a Camera

By HUGH S. DAVIS

Still Photographer, Martin Johnson African Expedition

PHOTOGRAPHS BY THE AUTHOR

IF you want to take pictures of nature subjects that are unusual you must have the patience to wait for them. A nervous bird will not sit patiently while you pose it for your negative. A high-strung rattlesnake will not "hold it" midway in its strike at a victim. You will never get prize pictures of natural history subjects unless you blend yourself right into the picture you're interested in getting. One must become a stump, a rock, or even stalk one's game on one's stomach. Commands get unnatural pictures, fearful expressions, harsh effects, or no pictures at all. Even if one wants an expression of fear or of anger on the subject, quiet, patient ways are best.

There are several reasons why really good nature pictures are no more common than they are. First, I shall list patience,

for this is the vital factor in obtaining unusual nature shots. The subject often is moving almost constantly, and the photographer does not have the patience to wait until a moment of non-movement is at hand. Then, too, an animal usually retreats into the shade and the film may be underexposed. Sometimes the would-be photographer is afraid of the subject. There is usually little danger, however, unless the subject is cornered, at which time it may do almost anything to escape.

Nature photographers are forever discussing their cameras, yet excellent pictures can be obtained with almost any type. If you have a small folding camera or a box fixed-focus type, and you wish to get close-ups, you will **need** a portrait lens. But for most **mammals** six feet is usually the closest you need get



BADGER

To the beginner in the field of nature photography, a zoo can be used as an excellent training ground. This badger, at the entrance to its den, was photographed at the Tulsa, Oklahoma, Zoo

anyway. It does not take a high-speed camera either, for your subject does not move all of the time. It is up to you to be patient until a still shot can be made, for your victim will now and then be quiet for a moment.

Personally I think the Graflex is the best kind of a camera for natural history pictures. The picture you are working for is viewed directly through the lens, making composition easy while expression or movement can be caught at the critical moment. However, I know several good nature photo-collectors who use only the small folding and box-type cameras, with excellent results. It is not so much in the machine taking the picture as it is in the patience of the engineer operating that machine.

All of us have some interest in animal life, for we are animals ourselves, and we like to record our association and contact with other animals. On vacations, fishing trips, or picnics, there are forever inci-

dents that make the trip worth remembering. It may be a mammal, a bird, an insect, or a repulsive yet fascinating reptile. Then, too, flowers form an interesting part of one's collection of pictures, and close-ups of flowers are sometimes exceptionally beautiful and effective.

If one intends to go very far with nature photography, one must have more than merely a camera, of course. How vivid is a picture in my mind of a night spent in a tree watching for bears in the high Colorado Rockies! And how often since then have I wished I had had a flash gun outfit for taking night pictures, so I could have captured a wee bit of that night on a negative!

On an early fall day a friend and I had built a small triangular platform between three spruce trees about twelve feet from the ground. In a clearing beneath those trees lay the carcass of a range steer that had died of loco weed, and had lately been torn into by a bear. Nearly an

hour before the full moon rose we were seated on our platform, each holding a high-powered rifle across our knees.

As the moon rose it flooded the mountain tops and the open park below with its pale, greenish glow. We in the tree tops sat patiently and searched the weird shadows for the shape of a bear. Then one shadow drifted through a clump of aspen trees in the dingy distance. Closer it came, turning over logs and shuffling along the forest carpet in search of grubs and bugs. Soon it came into the range of our vision below us and lay down. Another shadow moved in from another direction, and still another through the heavy spruce forest. There below us were three bears, and how I wished for some means to catch that little party on a negative! For only a short few minutes were we allowed to feast on such a sight,

then a twig cracked as one of us moved. But that sharp noise turned the whole scene below into a pell-mell rush for the dark aisles of the spruce forest. Through the underbrush they piled, sounding as if they were falling over every bit of down-timber they came to.

The crashing sounds faded into the distance and we were left perched on our platform gazing wide-eyed at a vanished picture. I had long since decided that the best way to record such experiences was with a camera and not with a gun. To have killed one of those bears from our vantage point would have been nothing but cold-blooded murder. To have photographed that setting would have called for the exercise of more skill and more patience, and if we had been successful photographers we would have bagged a finer trophy than a dead bear.



"SAY 'AH'!"

It is obvious that a picture like this of a wild hippopotamus could be taken only with the most amazing good fortune. Such a photograph is reasonably easy to obtain, however, of a captive animal



A MINIATURE DREADNOUGHT

The bizarre little western horned lizards will generally pose quietly for the amateur photographer. Their sorrowful expressions and weird armoring make them interesting subjects



AN AQUAINTANCE IN THE GARDEN

One need not feel that expeditions to distant lands afford the only opportunities for the camera hunter. A "hop-toad" may be found in almost any garden



ON THE DEFENSIVE

Some precautions are necessary if one cares to photograph poisonous reptiles such as this western diamond-back rattlesnake. Perhaps the beginner had better not attempt it at all



AN ARIZONA SCORPION

Small creatures like this are in a class by themselves, and the specialist in this field can readily find endless fascinating material



MACAWS

Tame birds and animals give the amateur photographer many opportunities to improve his technique

and green leaves absorb light. The old saying "expose for the shadows and the highlights will take care of themselves" is well worth remembering in shooting nature subjects.

Food stations will attract many kinds of animals and birds. So establish some of your

Since then I have gradually learned something of the art of camera hunting, though still I feel as if I were hardly through the first chapter of the nature photographer's primer—a book more fascinating, it seems to me, than any the gun sportsman has.

One need not be an adventurer or an explorer in order to obtain good nature pictures. There are probably hundreds of eyes peeping at you every time you step into the out-of-doors, especially if you happen upon a game trail, or follow along by the water's edge. Stalk through the aisles of trees, creep over the soft carpet of leaves and grasses, wade in swamps and shallow waters like a heron searching for frogs. Let yourself be a shadow and you will be surprised at the new world around you, and the many picture opportunities offered you. But remember not to be afraid to open your lens iris-wide, for shadows

own, set your camera solidly, attach a long string to the release, and hide away. You will be rewarded with many pleasant surprises.

Bird-life pictures are more difficult to obtain than those of mammals, for birds can fly away right at the moment of exposure. Cautious stalking and feeding at stations seem to be the best method to secure adult bird snaps. Nest and eggs are not difficult to photograph unless the quest takes one on an exciting cliff-scaling adventure. Then, too, the unexpected is likely to happen, such as finding nests with snakes coiled in them, or, while you



KIDS

Even domestic animals offer great opportunities, whether to the beginner or the experienced photographer

A DAYLIGHT FLASHLIGHT
This squirrel set off the flash at 10 A.M. and at the same time opened the lens by means of a string

are peering into a hollow tree expecting to see an owl, having a large black-snake glide past your face and escape by tumbling to the ground.

An amusing incident took place one day when I was drifting through the woods with my camera. I was bare-headed and had stopped to watch some birds ahead. I had remained perfectly quiet for several minutes when something lit right on top of my head and began pulling my hair. Then off flew a blue-gray gnat-catcher, perhaps wondering why my straw-colored thatch was so hard to pull out. This performance took place once more before I moved on.

To obtain the best results in bird photography one must remember that if the photographer remains motionless and is lucky a bird may mistake him for an old stump. And after all it would do anyone good to become a stump long



enough to glimpse some of the wonders of bird life.

Snakes present interesting possibilities to the photographer. They vary greatly in size, in coloring, and in habits. The fact that so many people dislike them or fear them seems, somehow, to make a good snake photograph doubly interesting and even the harmless species are a never-ending source of good photographs. Reptiles (especially snakes), when they are excited, are seldom still for more than a moment, and to get pictures of them one must be cautious and patient. Sometimes it takes hours to get the pose wished for in a snake. When photographing a poisonous species, it is safest to make a shield for the front of your camera, large enough to protect your hands, face, and arms in case the snake does strike. I have had large rattlesnakes and cotton-mouth moccasins strike the lens of my



A BABY WOODCHUCK
Young animals invariably arouse the interest of most nature lovers, and form charming camera subjects

camera on several occasions. However, that occurs very seldom and, in my experience, only when the specimen has been fresh caught.

Perhaps the most patient of all natural history subjects are the flowers. In working with them you can readily control the composition, but if a small camera is used, a portrait lens attachment is essential, and the distance must be checked carefully. If verichrome or plantachrome film is used, a yellow filter will be needed. The K2 and K4 filters are also useful in bringing out any cloud effects that may be in a sky-line flower shot. If supersensitive panchromatic film is used, some very beautiful color values will be taken.

A black cloth background brings out certain flowers in clear contrast, while a light background contrasts others. Patience is needed even on flowers, if the breeze is blowing, for there are some that seem to dance continually. If a butterfly alights on your subject, so much the better. A bee or a spider, too, will add charm to your composition.

Flower picturing will lead one to photographing insects. Such is the fascination of the nature photographer, leading from one branch to another, with increased interest as you delve deeper into it. Insects offer unusual shots and spiders

and their webs will always be a delight to the artistic camera hunter. The spider's handiwork covered with crystal beads of dew in the early morning sunlight is a subject that cannot too often be recorded.

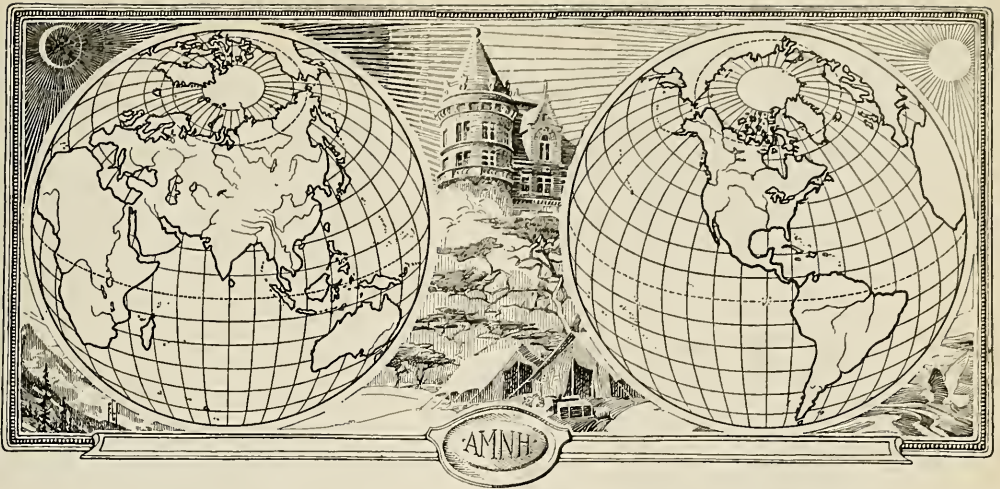
Fishes and all sorts of aquatic life furnish another field for the film, but once the camera hunter becomes interested in natural history photography, there is no limit to the field of subjects. Behind the lens you will find adventure, health, happiness, and a feeling of real sportsmanship that the gunner does not know.

To give technical information about what cameras, lenses, lens stops, and films are most desirable would be impossible. Under various conditions, we all work differently. The best advice one can have from any seasoned natural history photographer is to use common sense. Be continually on the watch for nature's unusual material and, above all, remember it is patience that rides hand in hand with success.

Every animal, bird, reptile, insect, and flower, if patiently studied, can be made to pay tribute to our store of human knowledge, and from these sources our own dull wits can gain much information. To stalk nature's subjects with a camera gives one the opportunity to study other lives besides his own.



Water Lilies



SCIENCE IN FIELD AND LABORATORY

Expeditions—American Museum Activities—Conservation—Education—
Meetings of Societies—New Publications

EDITED BY A. KATHERINE BERGER

EXPEDITIONS

THE SCARRITT PATAGONIAN EXPEDITION, which began its research into prehistoric South American life, climate, and geography in 1930, resumed its field work in Patagonia this fall.

The expedition—financed by Mr. H. S. Scarritt of New York—is headed by Dr. George Gaylord Simpson, associate curator of vertebrate palaeontology of the American Museum, with Coleman S. Williams as his assistant. Doctor Simpson and Mr. Williams left September 9 on the Grace liner "Santa Maria" for Buenos Aires by way of Valparaiso.

With them went a collection of original fossils and casts, together with a set of miniature life restorations of long-extinct North American camels. These collections are to be presented to the National Museum of Argentina, the head of which, Dr. Doello Jurado, has given the Scarritt Expedition and the American Museum every possible coöperation. Doctor Simpson will organize his expedition in Buenos Aires, and will do virtually all of his traveling by auto-truck. The country in which he will work is mainly desert and very sparsely settled.

The first phase of Doctor Simpson's Patagonian field work began in 1930-31 and lasted about eight months. It yielded much important information and unearthed some valuable finds, one of which was the discovery of the fossilized bones of one of the largest snakes that ever lived. The mounting of these bones was described in the September-October number of *NATURAL HIS-*

TORY by Doctor Simpson. His present field expedition will last six months or more.

MR. ROSWELL MILLER, JR. AND DR. HARRY L. SHAPIRO left September 21 on an American Museum expedition to the South Pacific Island of Tahiti. Mr. Miller will be engaged in zoölogical studies of the Tahitian coral reefs with the object of obtaining motion pictures in color of the coral reef life of the sea floor, while Doctor Shapiro will continue his previous investigations in physical anthropology among the natives of the island. Collections of marine life will also be made for the Museum. The expedition expects to return about December 20.

THE WHITNEY SOUTH SEA EXPEDITION, under the present leadership of William F. Coultas, completed during 1933 a survey of New Britain, Bismarek Archipelago. Special attention was paid to the fauna of the so far unknown mountain ranges of the interior, particularly to those accessible from the south coast. The next task of the expedition will be a thorough survey of the Admiralty Islands.

The American Museum received 1036 specimens of birds, a number of mammals, and other collections during 1933. The collections contained several new species and subspecies, numerous new records for New Britain, and also some very desirable material of rare species so far unrepresented in any American museum.

MR. RICHARD ARCHBOLD, research associate in the department of mammals at the American Museum, is at present in Urunu, Vanapa Valley, Papua. He and his party have recently completed a trip on Mt. Albert Edward, where some new and interesting birds were collected, namely, marsh hawk, quail, woodcock, and torrent duck.

ASTRONOMY

THE Amateur Astronomers Association holds its next meeting on the evening of November 1 at 8:15 o'clock, in the large auditorium of the American Museum of Natural History. American Indian Chronology as Indicated by Tree-rings will be discussed by Dr. Clark Wissler, and everyone interested in astronomy is cordially invited to be present.

The program as planned for the season of 1933-34 is as follows:

November 1, DR. CLARK WISSLER "American Indian Chronology as Indicated by Tree-Rings."

" 15, DR. HARLAN T. STETSON, "Cosmic-Terrestrial Relations."

December 6, DR. O. H. CALDWELL, "Electrons, Radio and Stars: Hearing Radio from the Stars."

" 20, DR. CLYDE FISHER, "Meteorites and Meteor Craters."

January 3, DR. HERBERT J. SPINDEN, "Mayan Astronomy."

" 17, DR. JOHN H. PITMAN, Subject to be announced later.

February 7, To be announced later.

" 21, DR. A. M. SKELLETT, "Meteors and Radio."

March 7, DR. CHARLES P. OLIVER, "Recent Developments in Meteoric Astronomy."

" 21, DR. JOHN A. MILLER, Subject to be announced later.

April 4, DR. CHARLES H. SMILEY, "Flying Mountains."

" 18, CAPTAIN J. F. HELLWEG. "The New Forty-Inch Telescope at the United States Naval Observatory."

May 2, MR. JOSEPH L. RICHIEY, "Astronomical Factors and Radio."

" 16, Annual Meeting, Motion Pictures.

BIRDS

THE Whitney Wing and the Tring Collection of Birds.—Of interest to ornithologists all over the world is an editorial that appeared in the *New York Times* of August 21, 1933. [It appears in full herewith:

A HOPE DEFERRED

The final annual report of Professor HENRY FAIRFIELD OSBORN, as president, to the trustees of the American Museum of Natural History, indirectly calls attention to the failure of the New York City administration to hold to the letter or spirit of a contract made with that institution. The default, moreover, is not only unjust to the Museum, but is an obstacle to scientific progress in many parts of the world. In March, 1929, the Board of Estimate and Apportionment accepted from the late HARRY PAYNE WHITNEY a gift of \$750,000, to be expended as one-half the cost of erecting and equipping on Central Park West a new wing of the building to be occupied by the Museum's department of birds. By the terms of this public-spirited gift the city became obligated to appropriate during the same year an equal sum, in order that the project might be pushed to rapid conclusion. Since last year, however, when the shell of the building was completed, failure of the city to provide its further share of funds has prevented the installation of cases. The ample balance in the sum provided by Mr. WHITNEY must be equaled dollar for dollar by the city before work can be resumed.

The default has also an international aspect. Early in 1932 the American Museum received as a gift from the family of Mr. WHITNEY a collection of 280,000 specimens of birds from all parts of the world, which had been assembled during forty years by Lord ROTHSCHILD in his Zoological Museum at Tring, England. The Tring Collection, although privately owned, was one of the outstanding scientific resources of Great Britain. Furthermore, the hospitality of the Tring Museum was proverbial, and its bird collections had long been more intensively studied by zoologists of many nations than those of any other institution. Loss of the Tring Collection was a serious blow to British naturalists and to those of Europe in general, but the authorities of our New York Museum believed themselves at least in a position to announce that the transfer of the Rothschild Collection across the Atlantic would in no sense limit its usefulness. Indeed, the early arrangement of the birds in fireproof and more spacious quarters, with the added advantages of the American Museum's already rich collections, and with the best of modern laboratory space and equipment for guest-workers as well as for the permanent staff, promised a new stimulus to ornithology in the United States without depriving foreign workers of equal benefit.

The promise, however, has proved fallacious, and the responsibility is clear. The studies of many British, German, French, Japanese and American ornithologists have been interrupted for an indefinite period. The priceless Rothschild Collection still reposes in packing boxes, with no possibility of arrangement, or even of adequate inspection, until the city fulfills its pledge to turn over the necessary new quarters to its overcrowded institution.

CONSERVATION

SCIENCE STUDIES GAME DEPLETION IN THE HUDSON BAY REGION.—Churchill, Canada's most northerly seaport, celebrated its opening as a summer tourist point early last August. Although the port has been open for commerce for two years, no passengers were allowed to proceed over the last ninety miles of the Hudson Bay Railway without a special permit until now because of lack of accommodation for visitors at the port. These restrictions have now been removed.

There were ten people in the first so-called tourist party for Churchill. These included a group from the University of Minnesota, among whom were Dr. Robert Green, professor of bacteriology, his assistant, W. J. Breckenridge, and their wives. In the Hudson Bay region they studied tularemia, the plague that causes a periodical dying-off of game. They trapped rabbit and grouse in order to isolate the parasites which are thought to live on grouse and rabbits and to be the germ carriers that spread tularemia. Doctor Green is of the opinion that the cycle of

game depletion can be lengthened and eventually eradicated through means that may eventuate from a scientific study of the causes of tularemia.

REINDEER REACH END OF LONG TREK.—

R. T. Porsild, reindeer expert of the Canadian Government, has returned to Ottawa after assisting to drive a herd of 3000 reindeer from Alaska to the Northwest Territories of Canada, east of the Mackenzie River. In Ottawa he will report to the government on the results of the drive and then return to the north to assist his brother, A. E. Porsild, in the final disposition of the herd which was bought by the Canadian Government to help the natives of the far north who have been suffering because of the depletion of the herds of caribou.

En route from Edmonton to Ottawa by the Canadian National Railways Mr. Porsild stated that last winter was one of the most severe in the history of the north for, although the temperature ranged only from 35 to 45 degrees below zero, there were frequent bad storms and the country was beset by wolves.

The herd of reindeer was bought in Alaska in 1929 and the drive has been taking place continuously since that time, except during the winter months, when the animals have been halted for grazing and mating. Mr. Porsild had charge of the provisioning of the herders during the long drive and he covered more than 2000 miles by dog team during the period of the drive, although the drive itself was only about 800 miles.

The reindeer have now been set free east of the Mackenzie River and, if they do not scatter themselves, they will be broken up into smaller bands by the herders, so that they will cover the whole of the north. The natives have been instructed how to catch and care for the animals, and it is believed the herd will prevent recurrences of those periods when many of the Indians and Eskimos faced starvation because of the disappearance of wild game.

EDUCATION

A SERIES of three free courses for New York public school teachers, available also for City College students, and covering "Foundational Visual Instruction," "Mechanics in Visual Instruction" and "Nature Studies for City Teachers," began on September 26th, 27th, and 28th, at the American Museum of Natural History under the supervision of that institution's department of education of which Dr. George H. Sherwood is curator-in-chief.

The courses, given in cooperation with the City of New York are being conducted by Mrs.

Grace F. Ramsey, associate curator, and Mr. L. Wales Holden and Miss Farida A. Wiley, staff assistants. The classes meet in the School Service Building of the Museum from 4:10 to 5:30 P.M. on Tuesdays, Thursdays and Wednesdays, respectively, for a period of fifteen weeks.

The "Foundational Visual Instruction" course is designed chiefly for teachers in service, and presents the basic philosophy and psychology of the visual method of teaching. Sources of material and equipment are considered, and opportunity is given for individual apparatus and materials,—stereopticons, motion picture projectors, methods of making homemade slides and project models. General techniques for the use of visual aids in various teaching situations are discussed, also the administration of materials and equipment ordinarily available in elementary schools.

The course dealing with "Mechanics of Visual Instruction" is planned for teachers who wish to learn the basic principles involved in the use of the common types of visual apparatus and familiarize themselves with such as are used for film strips and still films; the opaque projector; microprojector; 16 mm. motion picture projector and sound equipment.

The "Nature Studies for City Teachers" covers a period of fifteen weeks plus five Saturday field trips. This course is designed to help elementary and junior high school teachers to recognize specimens in the field or laboratory and to learn something of the structure, interdependence, and importance of nature.

Each of these courses may be taken for "alertness credit" and is given without any charge to teachers in the public schools of the city. They may also be taken for credit in City College with a registration fee of only two dollars.

The quota which can be accommodated in the course in "Nature Study" is already filled for the fall, but there are opportunities for teachers to register in either the "Foundational Visual Instruction" or the "Mechanics in Visual Instruction," both of which provide for individual laboratory work. Registrations are also being received for the course in "Social Studies" which will be conducted by Mrs. Ramsey beginning February 6, 1934.

In addition to these free courses two are being given under the auspices of New York University at the American Museum available to teachers registering through the University and paying the regular fee. One deals with the "Museum in Elementary Education"; the other covers "Astronomy for Teachers." Dr. Miriam B. Huber is conducting the former and Dr.

Clyde Fisher the latter. The courses started on September 27 and 26 respectively.

A free course of four informal talks on "The Appreciation of Gems" has also been arranged by the department of education of the American Museum. Mr. Herbert P. Whitlock, C.E., curator of minerals and gems at the American Museum, is giving these talks on Saturday afternoons at four o'clock. Two lectures were delivered on October 21 and 28, covering the subjects "What Is a Gem?" and "Jade: Its Carving, Mythology, and Symbolism." The subject to be presented on November 4 is "Decorative Stones other than Jade," and on November 11 "Legends of the Gems" will be discussed at the meeting.

A SPECIAL CONFERENCE OF TEACHERS of Free Day Adult Classes was held at the American Museum from September 5 to 14. The group of from 500 to 600 teachers assembled in the auditorium at 9 A.M. for group singing and to listen to addresses by various prominent educators, among whom were Dr. George F. Zook, Federal Commissioner of Education, and Dr. Lewis A. Wilson of the State Education Department. Director Sherwood welcomed the teachers and spoke of the Museum's facilities for teachers and pupils. Concerts were given each morning from ten to eleven. These were arranged by Mr. G. A. Baldini, Director of Musical Activities of the State Education Department. From eleven to one, small group conferences on various educational subjects were held in the classrooms of the School Service Building. Special guiding trips around the exhibition halls were arranged for the teachers by the Museum's department of education. The Museum was pleased to act as host to this group in the field of adult education.

THE Junior Astronomy Club, whose activities are organized and directed by its members, under the supervision of the American Museum's department of education in coöperation with the department of astronomy, started its fifth season on the evening of October 21, when Dr. Clyde Fisher spoke in Duplex Hall, School Service Building, on the marvels of the planetarium which is at last to become a reality for the American Museum. Doctor Fisher has delivered several lectures with the Planetarium at Chicago, and he made his audience anxious for the day when New York will have one of its own.

On this same evening the first edition of the *Winter Fieldbook*, just published by the club, was distributed to members. This is a very compact and complete booklet, following the style of the *Summer Fieldbook* which has been published

successfully for two years. It is well illustrated with maps and diagrams, and is full of projects for the amateur astronomer. It includes discussions of constellations, planets, variable stars, asteroids, sunspots, and almost every phase of observational astronomy. The articles, written by boys and girls who have actually made the observations, tell the reader just what and when and how to observe. It is a valuable addition to any library and will be especially helpful to students and teachers.

Although the articles are written by boys and girls, they are carefully checked by members of the American Museum staff. They retain their amateur flavor—but their accuracy is assured.

FREE SYMPHONY CONCERTS.—One of the outstanding features of the American Museum's summer program was the Friday afternoon series of free symphony concerts, presented by the Department of Education of the State of New York under the direction of Mr. G. A. Baldini, and sponsored by the American Museum of Natural History. A full orchestra of 83 trained musicians under the leadership of Mr. Rudolph Thomas, with Mr. Paul Eisler as guest conductor, has played most enjoyable and varied programs to large and enthusiastic audiences in the Museum auditorium. Several well known soloists have also appeared with the orchestra. On Thursday afternoon, September 7, Mr. Thomas conducted a special program for children, at which various instruments were played separately and explained.

MISS DOROTHY BENNETT, assistant curator in the department of education at the American Museum, spent the summer in the Southwest, doing archaeological work in the Jemez Valley, New Mexico, with the Field School of Archaeology of the Universities of New Mexico and Southern California. The school has exclusive rights to numerous sites, but this summer's excavation in the region was done in only one of the valley ruins—Unshagi. This was a pueblo village deserted shortly after the dawn of the Historic Period. After leaving Jemez, Miss Bennett visited several of the northern pueblo towns, including Taos, and then spent some time at the Puye, the Rito de Los Frijolles, and Mesa Verde.

MAMMALS

THE DEPARTMENT OF MAMMALOGY has recently purchased a small but interesting collection of forty-two Chilean mammals from the Island of Mocha, collected by Mr. D. S. Bullock. Forms of special interest are one recent

Pudu deer and one skull of the same discovered in a prehistoric refuse heap. Besides the above, one specimen of the rare marsupial, *Dromiciops*, and a series of the "mole-mouse," *Notiomys*, were received. Other mouse genera represented are *Euneomys*, *Akodon* and *Oryzomys*. It will be of interest to determine whether any members of the fauna of this island, located between twenty and twenty-five miles from the mainland, differ subspecifically.

THE LIBRARY

AMONG the new accessions of importance in the Library of the American Museum are: *Madrid Codex*. Maya Society Pub. No. 21. The Madrid Codex as it is today consists of 112 pages. It was at some early time separated into two sections which have been known as the Cortés and Troano Codices. The present is the only edition of both parts together. It is photographically reproduced, and is a very valuable addition to the Library's collection of codices.

Conchyliologie Fluviale de la Province de Nan-king. Fascicules 1-10. By Pierre M. Heude. Paris. 1875-1885.

Tret'e Puteshestvie v Tsentral'noi Azii. (Third Journey to Central Asia.) Russian Text. By Nikolai Mikhailovitch Przewalski. St. Petersburg. 1883.

Chetvertoe Puteshestvie v Tsentral'noi Azii. (Fourth Journey of Central Asia.) Russian Text. By Nikolai Mikhailovitch Przewalski. St. Petersburg. 1888.

These records of travels in Central Asia are by one of the most important early explorers of that part of the world, and are particularly pertinent to the work of the American Museum's Central Asiatic Expeditions.

DURING the latter part of July and August the following *Novitates* and *Bulletin* were published by the American Museum:

NOVITATES

- No. 647. *Studies of Peruvian Birds*. X. The Formicarian Genus *Thamnophilus*. Part II. By John T. Zimmer.
- No. 648. *A Study of Zenaida Auriculata*. By Elsie M. B. Naumburg.
- No. 649. *A Gigantic Ceratopsian Dinosaur, Triceratops Maximus*, New Species. By Barnum Brown.
- No. 650. *Two Stelis (Odontostelis) and a Melipona Bee that Have Been Recorded in Error as Anthidiinae*. By Herbert F. Schwarz.
- No. 651. *Birds Collected During the Whitney South Sea Expedition*. XXV. Notes on the Genera *Myiagra* and *Myiornis*. By Ernest Mayr.
- No. 652. *Two New Species of Frogs, Five New Species and a New Race of Lizards from the Dominican Republic*. By G. K. Noble and W. G. Hassler.
- No. 653. *Notes on the Genus Phoebe and the Description of a New Species*. By F. Martin Brown.

BULLETIN

Volume LXVI, Article 1. *A Systematic Revision of the Marsupial Genus Marmosa, with a Discussion of the Adaptive Radiation of the Murine Opossum (Marmosa)*. By G. H. H. Tate.

OTHER MUSEUMS

ON September 1, Dr. Roy Chapman Andrews returned to the American Museum after spending two months in Europe. While he visited France, Germany, Austria, Switzerland, and Jugoslavia, his longest stay was in Russia. In Leningrad he had a most delightful contact with the members of the Academy of Sciences who are actively prosecuting researches in many departments of science. Doctor Andrews was most cordially received by scientific and governmental officials, and found them all anxious to coöperate with the American Museum in scientific work.

The Natural History Museum of Leningrad, which is one of the oldest and most important in Europe, is particularly rich in collections of Siberia and northern Europe. Literally hundreds of remains of mammoths give the richest material to this museum. A unique exhibit is the mounted specimen of a mammoth which many hundreds of thousands of years ago had sunk in a bog. It had been immediately frozen and then covered with a thick deposit of frozen earth, and remained literally in cold storage ever since. Weathering exposed a small part of the body, and it thawed and decomposed under the rays of the sun. It was discovered by the dogs of native hunters who were attracted by the odor. The Academy of Sciences was immediately notified and arrangements were made to transfer the body entire to St. Petersburg. During the winter it was carried by sledge for nearly 1500 miles to the railroad where it was put into a refrigerator car and taken, still in its frozen condition, to the Imperial Museum. Russian scientists made exhaustive studies of its interior and exterior anatomy, and the skin was then mounted in the exact position in which it was found, namely tipped slightly back upon its haunches. The long hair with which it was covered is splendidly preserved in patches, and serves to give an accurate picture of the extraordinary beast as it was in life. During the last sixty years other remains of mammoths have been discovered which were in a partly frozen condition, but none so well preserved as this remarkable specimen. It makes an exhibit of which any museum may well be proud.

Dr. A. Borissiak, director of the Palaeontological Museum, has been carrying on explorations in Russian Turkestan during the past ten years. Although handicapped by a lack of money which has necessitated the use of ox carts for transportation, he has discovered many extremely rich fossil localities. These have yielded fauna much like that of the Gobi Desert. A



Photograph by Harry W. Smith

USING THE BLOW GUN

A group of Jivaro Indians with their native weapon, a closer view of which is given on the opposite page

composite skeleton of the giant baluchitherium stands in the museum as an awe-inspiring example of the life of the Central Asian Plateau during early Tertiary times.

Russian scientists are to be congratulated upon the progress which they have made in discoveries in natural science.

SCIENCE OF MAN

NEW ETHNOLOGICAL SPECIMENS.—A small collection of ethnological specimens from the Jivaro Indians of interior Ecuador has recently been donated to the American Museum by Mr. Harry W. Smith, who spent some time in that country. The Jivaros are famous for their custom of shrinking the heads of their captured enemies into small trophies—a practice which still stimulates conflict with the Ecuadorian government. Most interesting specimens in this collection are two ten-foot blow-guns and two dart quivers. The blow-guns are in a state of disrepair, which allows one to make close observations on their composition and the technique of their manufacture.

Blow-guns are made from the *chonta* palm, which is both hard and straight-grained. The guns are made in two pieces cut to a semi-circular shape and grooved on their flat sides. The grooves are also semi-circular in shape, and the straight grain of the palm allows them to be very evenly cut so that when the two pieces are placed together a remarkably clean one-quarter-inch bore results, which is later polished smooth with string, cloth, and sand. The two pieces are now bound tightly together with long thin strips of bark wound spirally around them. Then the whole binding is covered with black beeswax. Several layers of this kind may be applied. The two blow-guns in this collection have carved bone mouthpieces, and taper from about an inch and a quarter in diameter to three quarters of an inch. One has a raised lug near the mouthpiece end which probably served as a sight.

The quivers are made of a one-foot section of bamboo fitted with a woven cloth strip for carrying. The bamboo darts are about a foot in length and pointed at one end. They are scraped down to a delicate thinness. A large gourd is attached to each quiver. This contains cotton which is twisted around the dart before it is placed in the blow-gun. A small container of poison is also attached to the quiver. Finally each quiver has a lower jaw of a *piranha* (the biting fish) with sharp teeth as part of its equipment. Before shooting a dart, it is grooved with this sharp-toothed jaw about an inch from the point. The cotton wadding is twisted around it and the point is dipped into the poison. It is then placed in the blow-gun and expelled with a sharp puff at its target some hundred feet away. If the animal struck starts to run, the dart will probably break off where it has been grooved, thus leaving the poisoned point to work its effect on the victim.

Aside from the offensive weapons, the collection contains some ornaments. There are two sets of ear plugs in the shape of six-inch cylinders of bamboo, decorated by incision at one end. These are pushed through a slit in the lobe of the ears and project forward along the cheeks. Another type of ear ornament is represented by the beetle wing ear pendants. There is also a paint gourd with a two-pronged applicator with which the Jivaro Indian man improves his beauty with parallel stripes of red ochre.

The Jívaros like music to cheer their long hikes, and the pan-pipes of bamboo are favorite instruments. The one in this collection consists of twenty tubes arranged in a series of graded sizes which provide the variation in notes on their pentatonic scale.

Finally, there is a head-band bundle carrier of bark. It consists of a single long piece of bark, left flat in the strip that goes across the forehead and braided on the ends that binds the bundle to be carried.

Mr. Smith took many photographs, two of which are reproduced here by his permission. He also took motion pictures of the complete process of head-shrinking.—W. C. B.

BENJAMIN TALBOT BABBITT HYDE

IN the *Sante Fé New Mexican* of July 27, 1933, appeared the headlines, "'Uncle Benny' Hyde Dies of Injuries; in Crash." There followed an account of a car overturned, of three days' struggle in a hospital, and then—the end. An editorial in the same paper read in part:

"Thousands of boys in Santa Fé and in the East will be grieving to-day for their beloved Uncle 'Benny' Hyde.

"Eternally a boy, he loved all boys; and they gravitated to him as to a magnet. His life was one of boyish enthusiasms, sweetness, and generosity; of absolutely unselfish work to teach boys the secrets of the out-of-doors, to make them happy and healthy.

"Uncle Benny was in fact a unique institution. Under his perennial youthfulness was solid character. Few individuals have done more to build wholesome and manly citizenship hereabouts, and there has been no better citizen."

This same "Uncle Benny," known to so many leaders of out-of-door educational effort, throughout the country, was born in New York City on November 23, 1872, and christened Benjamin Talbot Babbitt Hyde. He was educated at St. Paul's School, Cooper Institute, Teachers' College of Columbia University, and Harvard University, where he was graduated in 1901. In 1906 he was elected president of the B. T. Babbitt Corporation. He was elected a trustee of Teachers' College in 1897 and a patron of the American Museum of Natural History in 1895. For three years he served as a manager

of the House of Refuge on Randall's Island. He became a trustee of the Cathedral Chapter of the Protestant Episcopal Diocese of Long Island, and in 1909 was elected a member of the board of managers of the University of Pennsylvania. From 1908 to 1910 he served as secretary of the Society of Industrial and Chemical Engineers.

Mr. Hyde may be said to have been a pioneer in the study of the archaeology of Southwestern United States. His interest in this subject was aroused by an exhibit of material from that area seen at the World Columbian Exposition in Chicago in 1893. With his brother, Frederick E. Hyde, Jr., he soon thereafter undertook to finance the exploration and excavation of cliff ruins, burial caves, mounds, etc., at Grand Gulch, Utah. The resultant collections were later presented to the American Museum. These enterprises were expanded in 1896 and, with the coöperation of the department of anthropology of this Museum and under its direction, the great Pueblo Bonito in Chaco Canyon, New Mexico,



Photograph by Harry W. Smith

A JÍVARO NATIVE WITH HIS BLOW-GUN

The bone-tipped blow-gun is held in one hand. Around the man's neck is hung one of the quivers now in the American Museum collection, together with the poison pot and the gourd for the cotton wadding

was excavated. These excavations continued under the patronage of Mr. Hyde and his brother for four years, through 1899. About half of this pueblo ruin was excavated, about 198 rooms, yielding many thousand objects illustrating the life and culture of its prehistoric inhabitants. This was the first systematic large-scale excavation undertaken in the Southwest. A publication detailing the excavation of Pueblo Bonito was issued by the American Museum in 1920, under the authorship of Mr. George H. Pepper, who had been the field director of the excavations.

In 1918, at the suggestion of Professor Henry Fairfield Osborn, Mr. Hyde joined the department of anthropology in the Museum, and assisted in the rearrangement and classification of the collections from Pueblo Bonito, preliminary to their publication as noted above. He also spent one season assisting Mr. Earl H. Morris in the excavations at the Aztec Ruin, New Mexico, then in progress. In the summer of 1920 Mr. Louis C. Cartier financed a trip to Grand Guleh, Utah. Mr. Hyde accompanied this expedition.

In 1903 Mr. Hyde joined several other donors as patron of an expedition to the Southwest by Mr. George H. Pepper, the main objective of which was to collect modern Pueblo pottery.

In the summer of 1920 Mr. Hyde began his work in nature education at the Boy Scout Foundation Camp in the Palisades Interstate Park near Bear Mountain, New York. At first, with very little support, he encouraged boys to really do things, in connection with their life in the open—to study nature—to make woodland acquaintances in a worth-while way. The first out-of-doors museum was established in the Pavilion at Kanawauke Lakes. After several years of work various camp museums were established, and finally the Palisades Interstate Park Commission, in recognition of the success of this effort, contributed toward the work with the result that five park museums were eventually established in the camping centers of the park. The Bear Mountain Trailside Museum, operated by the American Museum of Natural History, carries on this nature program for six months each year.

The outstanding achievements of Mr. Hyde's life were numerous. His interest in natural history education was a very real contribution to child life in America. For this service alone he will ever be remembered by those who were fortunate enough to come beneath his guidance. His understanding of child psychology was great; his devotion to his work was unstinted, and his ever jovial nature, even in the face of real

difficulty and the misunderstanding of his ideals by others, aided in carrying through the project nearest his heart.

It was in out-of-door museum work that Mr. Hyde was first known as "Uncle Benny." It became a term of endearment bestowed upon him by the host of children who learned to love him. From 1920 until the day of his death, increasing thousands of persons, young and old, called him by that name. It is as "Uncle Ben" that he will be remembered.—WILLIAM H. CARR.

MEETINGS OF SOCIETIES

ON July 21, the day preceding the regular sessions of the 16th International Geological Congress, which convened at Washington from July 22 to 30, a reception and buffet luncheon was given to the delegates in the beautiful Hall of Flying Birds at the American Museum. On the entertainment committee of the Museum were President F. Trubee Davison, Honorary President Henry Fairfield Osborn, Director George H. Sherwood, Assistant Director Wayne M. Faunce, Dr. Chester A. Reeds, and Mr. Herbert P. Whitlock.

Following the luncheon, Doctor Whitlock, chairman of arrangements, introduced Professor Osborn in a brief address summing up his distinguished achievements in the realm of geological science. Professor Osborn then extended a most cordial and open-hearted welcome to the delegates of the Congress, as follows:

As guests of the American Museum you are invited to enjoy our exhibition halls; to study our preparation laboratories; to examine our reserve collections; to note our peculiar methods of research; to observe our independent printing and publication; to visit the Library and study its methods of distribution and exchange with over 900 of the leading scientific institutions of the world; to note the special building devoted to public and scientific education, which touches the school, college, university and research life of the entire country. Then, after your journey to Washington and through America, you are especially invited to return to our Museum and take advantage of our warm hospitality to investigators from all parts of the world, selecting your own material for research.

You will see much that is entirely novel and, at first thought, even foreign to a natural history museum—for instance, that anthropology is under the same roof as zoology and geology, also that astronomy is embraced in our scheme of the sciences; still more surprising, that there is a very live department of experimental biology under Dr. Noble, and that in the building section to be devoted entirely to bird life there will be special provision for experimental ornithology.

You may wonder how these many branches are financed and how during the past twenty-five years it has been possible to expend no less than \$38,000,000 on the development of all these branches. People who do not know imagine that we Americans have the Golden Tree of the Chinese and that all that is necessary is to shake the tree for a shower of millions of money; this is very far from the truth—in fact, we have to work extremely hard for every appropriation and for every gift. I will tell you our secret:

So far as public funds from the State and municipality are concerned, we must demonstrate practically that we are a living and active force in the education of the vast and scientifically ignorant population that surrounds us. Accordingly, first, we touch 32,000,000 school lives each year and through this contact gain the confidence and eventually the warm friendship of the rulers of the City and State; second, knowing that the intelligent class includes not only money-getters but men and women of imagination and vision, we have sent out expeditions—on sea and land, on

the rivers, plains, mountains and deserts of every continent, to the Arctic and the Antarctic—under young and dauntless explorers who have the art not only of discovery but of writing interestingly about their discoveries, thus making it possible for us to popularize the expeditions in our many books, magazine articles and newspapers and arouse a once listless and indifferent public to the deep fascination of science.

These are our secrets, now used by many of our sister institutions in America, and we hand them all over to you, without reserve. Do not imagine for one moment, however, that we lose our perspective, for we spend far more money on scientific research and publication than we do on the popularization of knowledge, and we take far more pride and satisfaction in scientific coöperation and interchange of new and sound ideas than we do in any of the more obvious and visible exhibits and displays in which art and science are combined.

In closing, let me say that the American Museum is indebted beyond measure to the cordial and friendly coöperation not only of the scientists but of the governments that are represented in this Congress. Among our friends and allies are enrolled all the South American countries, all the governments of the great continent of Africa, most of the countries and institutions of Asia, all the institutions of Continental Europe, of Great Britain, Canada and Australia. From the old institutions of Europe we received our baptism and inspiration and we can never repay our indebtedness to them.

Of all the American institutions, that which stands foremost in cordial relation with the American Museum is the United States Geological Survey, with which we have been coöperating for the past thirty-three years and which published without stint our great monograph on the titanothere. Of the many positions I have the honor to hold in this country there is none I cherish more than the title conferred upon me in the year 1924, namely Senior Geologist of the United States Geological Survey.

At the close of Professor Osborn's talk, Mr. Whitlock introduced Prof. Waldemar Lindgren, president of the Sixteenth International Geological Congress, who said:

On behalf of the Committee on Organization I wish to extend a hearty welcome to the members of the Sixteenth International Geological Congress, who have arrived in this country in order to take part in the meeting which will open in Washington tomorrow. New York is the great gateway to this country from Europe, and we have no doubt with us today the majority of our foreign members. I am delighted to have the opportunity to meet you here, and particularly desire to express my sincerest thanks to the president and officers of the American Museum of Natural History for their courtesy in inviting us all to visit their beautiful and complete exhibits, and to afford an opportunity to become acquainted. Many of you have already taken part in the preliminary excursions provided for the Congress, and many more will remain to follow the excursions across the country, which will come after the meeting in Washington. You may be sure that the Committee on Organization will do everything in its power to make you comfortable and to further your objects.

The Geological Congress is meeting again in this country after more than forty years. The science of geology and the knowledge of the geology of the United States have made vast progress since that time. Consider the fact that the U. S. Geological Survey had hardly been organized more than ten years at the time of our last meeting here. Consider also, if you please, the amount of work carried out by the members of the Geological Society of America, in that time, and the work of all the State Surveys. We owe a great debt to these organizations, particularly to the two first mentioned. Without their active assistance, the task of the organizing committee would have been almost impossible.

The next speaker was Prof. Charles K. Leith, of the University of Wisconsin, who, as President of the Geological Society of America, welcomed the delegates. He spoke briefly and to the point, saying that his hearers would doubtless enjoy examining the abundance of geological material which surrounded them more than listening to speeches. He added that Nature had richly endowed this country with materials of geological interest and expressed the hope that his hearers might have the privilege of remaining after the Congress sessions so that they could take advantage of the excursions to some of these points of special interest.

At the close, Sir John Flett, Director of the Geological Survey of Great Britain, arose and said that he felt the group should not disperse without expressing in some way the appreciation felt by the delegates for the hospitality extended to them by the American Museum. He expressed his admiration for the great scientific institution in which they were assembled and said that he felt that in the building up of a great educational work it was laying a splendid foundation for making the people of America museum-minded. In the services rendered by it to the state and to science he felt the institution worthy to act as a model for similar institutions elsewhere. In conclusion he said that he wished to express on behalf of the foreign delegates their appreciation of the generous welcome which had been extended to them upon arrival in this country.

BYRD ANTARCTIC GROUP FOR THE AMERICAN MUSEUM

JUST as NATURAL HISTORY goes to press, word comes that Admiral Richard E. Byrd has generously consented to collect for the Hall of Ocean Life of the American Museum a group representing the birds and animals of the Antarctic, on his forthcoming expedition. The walrus group, now partly completed, representing the animal life of the Arctic, will be transferred to the north side of the Hall. Opposite it will be installed the proposed Antarctic group that will consist of crab-eater and Weddell seals, and also the rare sea leopards and Ross seals. Penguins of two species and other sea birds will help to make a very attractive and interesting group. In the

background will be shown the ice of the Great Barrier. Material for the group will be collected by Mr. Paul A. Siple, and Mr. Lindsay, biologist of the expedition. The group will be dedicated to the Byrd Antarctic Expedition II. The American Museum is to be congratulated on this splendid opportunity to obtain a striking group for its great Hall of Ocean Life.

Incidentally, the old coast guard cutter "Bear" is to be put to work again on this expedition. A cruise of the "Bear" was described by Alfred M. Bailey in the September-October issue of NATURAL HISTORY.

NEW PUBLICATIONS

BOOK REVIEWS

Fishes. Their Journeys and Migrations. By Louis Roule. Professor of the National Museum of Natural History in Paris. With an Introduction by William Beebe. Translated from the French by Conrad Elphinstone. W. W. Norton & Co., Inc., N. Y. 270 pp., 54 text figures.

PROFESSOR ROULE is the author of various technical and scientific papers on the subject of fish migration, incidental to recent fisheries investigations of which it has formed an important part. This book is significant in that it presents in popular and very readable form his views on the life histories and migrations of a representative series of European fishes, applicable to fishes of the world in general. He finds fish migration primarily a movement to and from favorable breeding grounds, and that there is no difference in principle between the movements of fishes which assemble for the purpose of spawning near where they have previously led a more scattered existence, and of those which travel great distances for the same purpose. He emphasizes, perhaps over-emphasizes, the conclusion that simple environmental factors such as amount of oxygen in the water, temperature, and salinity automatically initiate and direct the movements of each individual fish, as its changing physiological condition with the approach of the breeding season puts it out of harmony with its previously satisfying environment. The whole mechanics of the migratory phenomenon in the different species is logically explained, and life history details as yet imperfectly known are hypothecated to fit. Students with a wealth of data at command bearing on the subject, will realize that this is not the last word, that there is very likely a greater complexity of factors involved. They will do well, however, to give serious consideration to the book and also to the

natural philosophy presented therein, which will still more interest the general reader for whom it is primarily intended.

This book might be called a philosophical discourse; lightly and pleasingly written, full of the beauty of the outdoors and of natural phenomena, and which never strays far from the practical human aspect of life. The large amount of scientific information that it carries is unobtrusive. Life histories of trout and salmon are discussed at length; and the facts of the life history of the fresh-water eel which spawns only in the deep sea, are presented in a very dramatic manner. It is too bad there is no index to enhance the volume's reference value.—J. T. N.

Traveling With The Birds. A Book on Bird Migration, by Rudyerd Boulton, Field Museum of Natural History. Illustrated by Walter Alois Weber. M. A. Donohue and Co., Chicago; New York. 4 to; 64 pages; 12 full-page colored plates; 23 text-cuts.

THE story of bird migration is never old. It appeals alike to young and old, and Mr. Boulton's text is addressed to both. He writes of "The Bird's Engine," its "Chart and Compass"; discusses the reasons for their migrations and tells of some "Long Distance Champions," "Stay at Homes," and "Bird Gypsies." All this is done in a manner at once authoritative, entertaining, and instructive, and thanks to Mr. Weber's illustrations, many of his subjects are introduced in a manner that is bound to arouse our interest in their welfare. We recall, indeed, no more attractive portraits of certain North American birds than those that appear in this volume. So, between author and artist we have a book that may well serve as an introduction to the study of birds. And to their combined efforts the publisher has added the miracle of producing this beautiful volume for the price of one dollar!—F. M. C.

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BLAZING THE TRAIL

AMBERGRIS—"floating gold," as Robert Cushman Murphy calls it—is that most romantic substance that perfumers require in the manufacture of their most alluring scents. To be quite frank, we of *NATURAL HISTORY* knew little enough about it until we persuaded Doctor Murphy to write an article on the subject, but now we feel marvelously well informed, for the article has been completed and we plan to present it in two parts, which will appear in the March-April and the May-June numbers.

THE big trees of California are generally accepted as the greatest living things, but there are other giants in the botanical world. Dr. Clyde Fisher, at our earnest solicitation, has written an article on these great plants which we have scheduled for the March-April number of *NATURAL HISTORY*, and which, we believe, our readers will find exceptionally interesting.

THE ancient inhabitants of South America have left innumerable ruins as a partial record of their amazing activities, and the American Museum has sent many expeditions to study them. The most recent was that led by Dr. W. C. Bennett whose article entitled "Peruvian Gold" appeared in the January-February, 1932, number. In the next number Doctor Bennett will describe some of the more interesting of the studies and discoveries that he made on his 1932 expedition.

IN this department of the last Magazine we made a promise that we have not fulfilled. We announced to our readers an article by Alfred M. Bailey, director of the Chicago Academy of Sciences, on the avocet, and when we finally came to lay out this issue of the Magazine we found that the article could not be made to fit except by treating it in the Procrustean manner. We object, however, to lopping off

portions of Mr. Bailey's articles, and in this particular case we were fortunate in having another article by the same author. This we substituted, and now we promise faithfully to publish the article on the avocet in the March-April number.

ARCHERY seems to have made great strides in popularity in recent years, and it is not unlikely that many of our readers are archers of repute. It is not likely, however, that many of them are acquainted with the technique of Japanese archery which differs in many extraordinary ways from the art as developed in the West.

For the next number of *NATURAL HISTORY*, Shiochi Ichikawa gives a fascinating account of Japanese archery which our readers, whether they are archers or not, will undoubtedly enjoy.

MR. JAMES L. CLARK, vice-director of the American Museum, in charge of preparation, has had more than a little experience in the field. For the next number of this publication, he tells of collecting in a lovely valley in the heart of Asia—a valley cut off from the rest of the world by deserts,

glaciers, and barren rock fields.

GEORGE GAYLORD SIMPSON, whose delightful article entitled "Children of Patagonia" appeared in the March-April, 1932, number, has prepared an article descriptive of a paleontologist's day in the field. It is with real pleasure that we announce it for the coming number.

DR. ROBERT T. HATT, of the American Museum's department of mammalogy, has written an article on those strange rodents which have developed long and powerful hind legs that make it possible for them to leap in a most kangaroo-like manner. This article, too, is to appear in the next number of *NATURAL HISTORY*.

WILD ASSES ON THE GOBI DESERT

THE painting for the cover of this issue of *NATURAL HISTORY* was made by Arthur A. Jansson, staff artist. It depicts a herd of wild asses which have been feeding on the scant vegetation of the Gobi Desert. A wolf has sneaked upon the herd, taking advantage of rocks and irregularities of the ground, hoping to get near enough to the herd for a quick dash upon one of the colts. He has been scented by the asses, however, and they are in full flight. The wolf does not make an attempt to pursue them, knowing that with the start they have he could not hope to catch them. The greatest speed of the Mongolian wolf, Doctor Andrews learned after repeated tests, is thirty-six miles an hour, while many of the wild asses can reach forty miles an hour for a quick dash. The wolf is the only natural enemy of the wild ass and probably seldom attacks adults.

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BLAZING THE TRAIL

TWENTY-FIVE years ago Prof. Henry Fairfield Osborn succeeded Morris K. Jessup as president of the American Museum of Natural History. Now, after a quarter of a century in that capacity, Professor Osborn has resigned and has been elected Honorary President by the Board of Trustees. To attempt to recount all the important events in these active years would be all but impossible, but Dr. William King Gregory, in an article entitled "The Master Builder—Henry Fairfield Osborn," which will appear in the next number of *NATURAL HISTORY*, tells of the great value to the American Museum, to education, and to science, of Professor Osborn's activities.

IN these days of problems and economic disaster for the farmer, it is interesting to understand the immeasurable effect that agriculture has had on the development of civilization. Our other industries are, for the most part, parvenus by comparison. Rarely do we think of farmers as being representatives of the oldest of the world's industries, and though we accept food as a necessity, we are not apt to think of agriculture as one of the greatest of civilizing forces.

NATURAL HISTORY is fortunate in being able to publish in the next number an article by Dr. Elmer D. Merrill, of the New York Botanical Garden, on "Crops and Civilization," and we who have read it do not hesitate to recommend it as one of the most interesting and important contributions that we have been privileged to present.

THERE are phantoms that even science is willing to accept, and it is about these that Herbert P. Whitlock, of the American Museum's department of mineralogy, has written an article for the next number of *NATURAL HISTORY*.

These phantoms are, however, ghosts of crystals that can be seen and even photographed, and that show various stages of crystalline growth, more or less as tree rings show the growth of the giants of the forests. That this parallel is far from scientifically accurate must, of course, be apparent. Mr. Whitlock, however, explains the matter much better than we are able to do, and we shall present his story in the next number.

MASTHEADS

THE cover painting of this issue of *NATURAL HISTORY* by Arthur A. Jansson, staff artist, depicts the foretopmast of the whaling brig "Daisy," in which Dr. Robert Cushman Murphy once made a year's voyage, as told in his article "Floating Gold."

The mastheads, as the lookouts are called, are the eyes of a whale ship. Perched on a platform a hundred feet above the deck, armed with binoculars, and fortified with a promise of five pounds of tobacco for the man who "first raises a whale" which is subsequently captured, the mastheads stand two-hour watches from dawn until dark. It is their duty to report everything of interest to the captain—not only whales, but ships, squalls, flotsam, fish, and birds. Their post is dizzy enough in rough weather, but it may become a sleepy one when, in the words of Melville, "the waves nod their indolent crests, and across the wide trance of the sea east nods to west, and the sun over all."

TO the casual visitor the prairies that merge into the foothills of the Rocky Mountains seem to be almost deserted regions. To such an observer and photographer as Alfred M. Bailey, however, many birds and animals that most of us would miss become fascinatingly evident there. Mr. Bailey, whose articles are familiar to *NATURAL HISTORY* readers, has written another about these western prairies. It will appear in the May-June issue.

OF late much has been published in the newspapers about meteorites. Most of us know little enough about these strange visitors, and *NATURAL HISTORY* is consequently delighted to be able to publish in its

next number an article on the subject by Dr. Chester A. Reeds, curator of geology in the American Museum.

MR. W. H. CARR has written another of his interesting articles for the May-June *NATURAL HISTORY*, describing the human and somewhat amusing reactions of one of the many visitors to Trailside Museum at Bear Mountain.

FOR the next number Mr. William G. Hassler has written about his experiences and the activities of the expedition of which he was a part, in Haiti and Santo Domingo.

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BLAZING THE TRAIL

AS between the appeal of the beach and the mountains there is, at least from now until autumn, some considerable difference of opinion. The readers of the next number of *NATURAL HISTORY*, however, will find the beach so attractively described by Dr. Robert Cushman Murphy in his article "August on Fire Island Beach," that it may be that the mountains will suffer by comparison. This, of course, is not our purpose in publishing the article. We try to maintain a sort of Olympian detachment in such arguments. It tends to keep us out of arguments ourselves.

ON the first of May, which is the publication date of this issue of *NATURAL HISTORY*, the new Hall of Ocean Life will be opened at the American Museum. This, the largest of the Museum's halls, might to excellent advantage have been described in this issue of *NATURAL HISTORY*. But we of the magazine staff, having looked in at the breath-taking array of blocks and tackles, enormous whale skeletons, the great groups of sea elephants, sea lions, fur seals, and manatees, the incomplete but extraordinary coral reef group, the models of the killer whale, the giant squid, and the porpoises, the completely equipped whale boat, the beautiful murals of whaling scenes, and all the rest of the extraordinary collections that have for so long been coming together beneath the wide spreading ceiling of this enormous hall, realized that the task for the present was to open the hall and not to write about it. For the next number, however, Curator H. E. Anthony will describe this new hall, and we of *NATURAL HISTORY* are more than usually pleased to be able to publish this article for the information of those who read our magazine.

CARRIER pigeons are romantic birds, properly of interest to everyone. And in the hands of the experts in the United States Army, they

have been trained to perform amazingly. For the next *NATURAL HISTORY*, Lieut. Carter W. Clarke, U. S. Signal Corps, tells a most fascinating story of the success that has been attained in training certain of these birds to fly at night, an activity apparently highly foreign to their nature.

JUST what it is that turns the attention of so many people from pug dogs to Scotties we have never been able accurately to determine, which does not at all mean that we do not like Scotties. But the growing interest among former goldfish owners in tropical fish is, at least for us, far easier to understand. These delicately colored, fantastically shaped little fellows seem, sometimes, almost too delicate to be real, and it is a pleasure to be able to announce for our next number an article about them by Mr. C. W. Coates. Mr. Coates is an authority on these sprites, and is a member of the scientific staff of the New York Aquarium.

BIRD songs are among the loveliest of Nature's sounds, yet many of us, especially when tied to work in the city, hear fewer than we wish we could. There is a member of the scientific

staff of the Museum, however—Mr. Albert R. Brand—who has developed a recording machine with which he goes out into the woods and fields and makes "sound tracks" of these songs together with motion pictures of the feathered singers. In the next number of this magazine Mr. Brand will describe his work, his machine, and his results.

FROM Mt. Katahdin, Maine, to Mt. Oglethorpe, Georgia, there runs the "Appalachian Trail." Here, those who love the woods and trails and Nature in the wild, may ramble to their hearts' content. Mr. William H. Carr describes in our next number this extraordinary woodland path.

THE COVER PAINTING

THE cover painting of this issue, by Arthur A. Jansson, staff artist, represents an Indian corn field, an appropriate frontispiece to Dr. Merrill's interesting story of the important contributions to civilization made by the prehistoric Indian. We see here a field characteristic of what is now the eastern half of the United States, in which large area woman was the farmer and man the hunter. Our colonial forefathers learned to grow corn in the Indian way, and what is more, have made surprisingly few improvements except in the way of cultivating machinery. The hoe and the digging stick were the only farming tools used by the Indian woman. The artist shows us the corn field when the milk is in the ear, and we may well imagine this to be the first gathering of the season, to be served at a festival generally known as the Green Corn Dance. The woman knows which are the mature ears, while the girl is profiting by observation and occasional instruction, thus acquiring the necessary wisdom to take her turn a few years later.

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BLAZING THE TRAIL

THOSE portions of the earth's surface that are unknown to man are steadily becoming fewer and our astronomers are penetrating farther and farther into the infinite distances of outer space. Yet almost within arm's length—certainly within the distance of a few yards—lies a whole new world visited, as yet, by very few competent observers. This new world is that of the under-sea, where countless forms of life that to most of us are utterly strange and almost unreal are to be found by those who know how and where to look. In the next NATURAL HISTORY Dr. Roy Waldo Miner will tell of his experiences beneath the sea in the shallow waters of the Bahaman reefs, where for years he has been studying the fauna and the flora of the sea bottom.

FOR more than thirty years NATURAL HISTORY MAGAZINE has been publishing articles written by explorers about their expeditions, yet in all that time very little of the problem of preparing for the field has been presented. Now, however, Mr. James L. Clark, one of the American Museum's most experienced field representatives, has written an article on what preparations must be made before an expedition can become a successful reality. To those who contemplate, in fact or in fancy, any expedition into "the field," this account, which will appear in the next number, will be highly enlightening and entertaining.

THE old revenue cutter "Bear" was long the official watchguard of the Alaskan coast, and many times has shouldered her way through Arctic storms and ice floes. Now she has left those duties to a newer ship, but Alfred M. Bailey, who has cruised the Arctic on the older vessel, has written a fascinating account of what Arctic voyaging means, and we are delighted to be able to publish it in the coming issue of our magazine.

WILLIAM H. CARR, who has an unusually interesting way of telling of his experiences

with the birds and animals with which he comes in contact in his work at the Bear Mountain Nature Trail, has written for our next number an account of a flicker which possesses characteristics all of its own. This story will be called "Peter Poses."

MRS. N. C. NELSON, who, with her husband, has spent considerable time in the interior of Korea, has a very happy faculty of writing of her experiences, and we of NATURAL HISTORY are delighted to be able to announce that an article by her will appear in the next number. From it our readers will obtain some new impressions of what an American woman sees in this ancient land of the Far East.

AKELEY African Hall, after many years of planning, of field work, and of preparation, is at last taking shape, and probably before the year is out will be opened, in part at least, to the public. To those of us who know the vast amount of thought and labor that has gone into this amazing hall since Carl Akeley first proposed it, its size and problems are reasonably familiar. To those

less fortunate, however, the gigantic problem it has presented is less clear. For our next number, in an attempt to illustrate the complexity of such a hall, Mr. Albert E. Butler of the American Museum's department of preparation, has written an article descriptive of the labor that is involved in the preparation of one of the great groups. This, multiplied by the number of groups in the hall, will give some idea of the time, the labor, the experiences, and the expense that such a hall requires.

IN the next number of NATURAL HISTORY MAGAZINE there will appear a remarkable series of photographs taken in India by Mrs. Herman Cron. These photographs are among the most attractive and interesting camera studies of natives it has ever been our privilege to publish.

GREEN HERON ON FIRE ISLAND BEACH

THE cover painting of this issue, by Francis L. Jaques, staff artist at the American Museum, depicts the familiar "shy-poke" standing at the shady edge of a forest patch near Point o' Woods, Fire Island Beach, with sunlit marsh and thicket of the Great South Bay shore in the background.

The painting illustrates one of the several aspects of nature on the Fire Island barrier, as described in Doctor Murphy's article. On the southerly coast of this attenuated sandy strip, the waves of the turbulent Atlantic pound and destroy, and build up again; on the northerly side the sheltered waters are peaceful, and changes in the shore line are perceptible only during the course of years. In between these diverse water fronts is a surprising mixture of dunes, swamp, and forest, with rich plant and animal life, and certain tracts which approximate primeval conditions. It is with the hope that parts of this interesting terrain may be preserved as State Sanctuaries that Doctor Murphy's story has been written.

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BLAZING THE TRAIL

DOCTOR FRANK E. LUTZ of the American Museum's department of entomology has been carrying on a series of experiments with ultra-violet rays in order to determine the ultra patterns in insect colorization and the ability of certain insects to see these patterns which are invisible to the human eye. In the November-December number of NATURAL HISTORY an article will appear on this subject by Doctor Lutz, and we can assure our readers that they will find it not only new and unusual, but highly fascinating as well.

DOCTOR GEORGE VAILLANT not long ago wrote an article which appeared in NATURAL HISTORY MAGAZINE descriptive of the City of Mexico prior to the advent of the Spaniards. For the next number he has written a somewhat similar article on Chichen Itza, the great Maya city of Yucatan. Our readers are already familiar, because of the material published by NATURAL HISTORY, with much of the work that has been carried on among these ruins. Doctor Vaillant's article will, however, present a new picture of this, one of the greatest pre-Columbian cities of America.

WHAT will the average man be like 500,000 years from now? Since man is intimately associated with nature and is definitely fixed in a social setting, significant alterations in either of these environments might conceivably change the course of human evolution. Dr. H. L. Shapiro, associate curator of physical anthropology in the American Museum, will discuss in the next issue of NATURAL HISTORY this most absorbing topic under the title "The Future Man."

SEVERAL times NATURAL HISTORY has had occasion to present an article or notes

concerning "Meshie," the chimpanzee brought from Africa several years ago by Mr. H. C. Raven of the American Museum staff. Meshie has created a most interesting impression upon everyone who has met her, and Mr. Raven's accounts of this fascinating animal have invariably attracted the attention of large numbers of our readers. For the next issue Mr. Raven has written further concerning her many accomplishments.

A BAHAMAN CORAL GARDEN

IN the cover painting of this issue a diver on one of the American Museum's expeditions to the Bahamas is depicted investigating the outside of the Andros Barrier Reef from the sea floor. Equipped with a diving helmet, he has descended to a depth of four fathoms and is entering the edge of a submarine forest of huge limestone trees of elkhorn coral, amid waving sea fans and schools of brilliantly colored fishes. In the immediate foreground several rock beauties (*Holacanthus tricolor*) swim up almost to the diver's helmet. In the upper right, a large blue parrot fish (*Scarus coeruleus*) noses about among the coral branches. In the upper left middle distance two banded butterfly fishes (*Chaetodon striatus*) are flitting hither and thither in search of food particles in this submarine fairyland.

The Andros Barrier Reef extends for a hundred miles along the eastern coast of Andros Island in the Bahamas, and is the region to which Doctor Miner conducted five expeditions during the last ten years to secure the studies and material for the great Coral Reef Group now approaching completion in the American Museum's Hall of Ocean Life.

MT. KENYA is one of the landmarks of East Africa. At its base and upon its precipitous sides a varied and interesting fauna lives. Dr. James P. Chapin, associate curator of birds of the Eastern Hemisphere, having spent much time in Africa and being rather intimately acquainted with the bird life of this great mountain, has prepared for the next number of NATURAL HISTORY an article on this region. Those who have read any of the numerous articles Doctor Chapin has written in the past for the magazine will, we are sure, look forward eagerly to the subject with which he is so intimately familiar.

A BIRD that nature has liberally equipped with all the toilet requisites for as elaborate and painstaking a grooming as any

fastidious lady of fashion could demand for herself, will be the subject of an article by Lord William Percy which NATURAL HISTORY expects to publish in the November-December issue.

SEVERAL additional articles of current interest will also be included in the November-December number of NATURAL HISTORY, together with a resumé of the highlights of the Sixteenth International Geological Congress held at Washington, D. C., during this summer.

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WHAT COLORS DO INSECTS SEE?

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BLAZING THE TRAIL

FOR the next number of *NATURAL HISTORY* G. Kingsley Noble, curator of the American Museum's department of experimental biology, has written an article on certain experiments with lizards. The work itself is highly scientific, and would be difficult for the layman to comprehend, were it not that Doctor Noble has written a simple, popular exposition that is highly interesting and almost entirely non-technical.

NONE of the contributors to *NATURAL HISTORY* are more widely known or more universally popular than Frank M. Chapman. It is undoubtedly true that Doctor Chapman has had more to do with the development of bird study and the growth of popular interest in birds than any other man in America. *NATURAL HISTORY* is always glad to publish his articles, and is especially pleased to announce the appearance, in the next number, of an account of certain of his observations in the suburbs of Miami, Florida, where he spent last winter.

FROM the days of Marco Polo, Asia has attracted a long list of travelers and explorers, among whom Roy Chapman Andrews, vice-director of the American Museum, ranks high indeed. *NATURAL HISTORY* has published many articles written by Doctor Andrews, and we have found that our readers invariably accept them as being among our very best contributions. It is with real pleasure, therefore, that we announce for the next number an article entitled "Nomads of the Desert," in which Doctor Andrews describes the Mongols of the Gobi, and tells much about their lives and customs.

ODD corners of the world seem to have an especial fascination to Suydam Cutting, a trustee of the American Museum and a world traveler of the first rank. Mr. Cutting's articles have appeared from time to time in *NATURAL HISTORY*, and we consider ourselves fortunate to

be able to inform our readers that another—this time on a "tiger drive" in India—is to appear in the January-February number.

BIRD sanctuaries are of comparatively recent origin, and it is likely that few of our readers realize just how widespread they are in the United States. The National Association of Audubon Societies has been a leading influence in their establishment, and many sanctuaries are under the supervision of this organization. For the next number of *NATURAL HISTORY*, Mr. Ernest

Holt has written a most informing article on this subject.

DARWIN'S home is now a scientific shrine of universal interest and importance, and is no longer in private hands. For the next issue of this magazine, Benjamin Spector, professor of anatomy, Tuft's College Medical School, has prepared an article on this great scientist's home. It will be illustrated with what is probably the first complete set of photographs of the subject to appear in print in America.

ROBERT H. ROCKWELL, of the American Museum's department of preparation, has spent more than a little

time collecting for the American Museum. One of the most important phases of his work in the field had to do with the collection of African buffalo when he was a member of the Eastman-Pomeroy-Akeley Expedition. Undoubtedly buffalo are among the most interesting of the animals of Africa, and a reader need go no further than Mr. Rockwell's account in the next issue of *NATURAL HISTORY* to realize that fact.

THE second part of James P. Chapin's account of climbing Mt. Kenya, in Kenya Colony, Africa, will appear in the next number of *NATURAL HISTORY* Magazine. This installment of the article will include several delightful drawings of African birds by Mr. Francis L. Jaques.

WHAT COLORS DO INSECTS SEE?

THE cover of this issue of *NATURAL HISTORY* reproduces a painting in which Mr. Arthur A. Jansson shows us a beautiful butterfly's colors as we see them. But, if Mr. Jansson had been looking through the eyes of a butterfly or of some other insect, instead of through human eyes, and had been interpreting the insect's sensations, what colors would he have used?

We cannot give a complete answer to this question; but we can say quite definitely that the painting would be very different, and we can point out where some of the changes would be made. What we call pure red would match what we call a rather dark gray. But part of the red and the blue on this butterfly are not "pure." They are tinted with an ultraviolet color or colors which insects, but not humans, can see.





